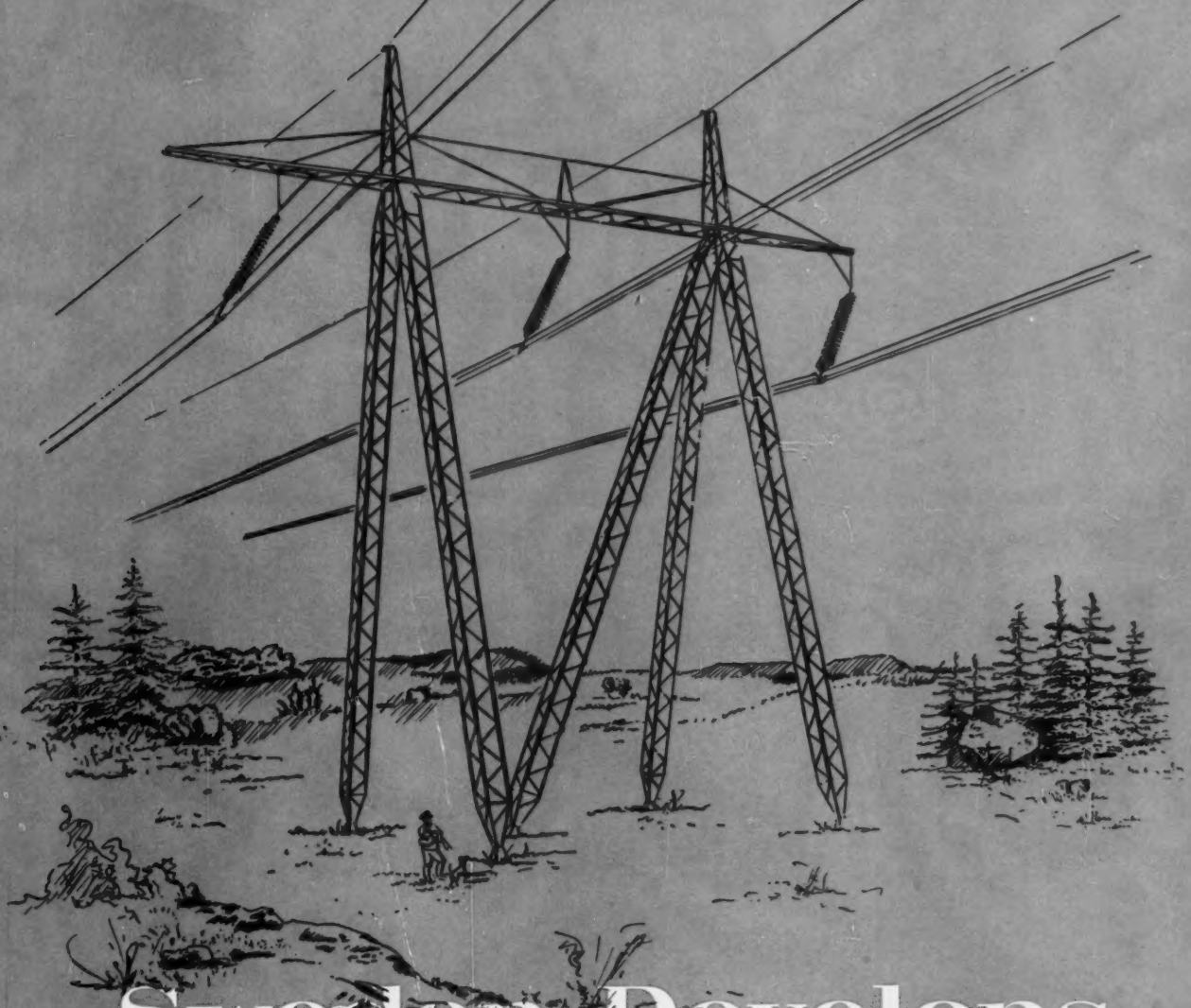
The Electrical Industry's Weekly Magazine August 1, 1960

Electrical World

Price 50 Cents

A McGraw-Hill Publication



Sweden Develops New 380-Kv Towers

...page 36

ALSO IN THIS ISSUE:

Sherman Knapp tells platform writers investor-owned utilities are entitled to equality on tax, money cost, and power availability.....p 24

UNIV MICROFILMS INC
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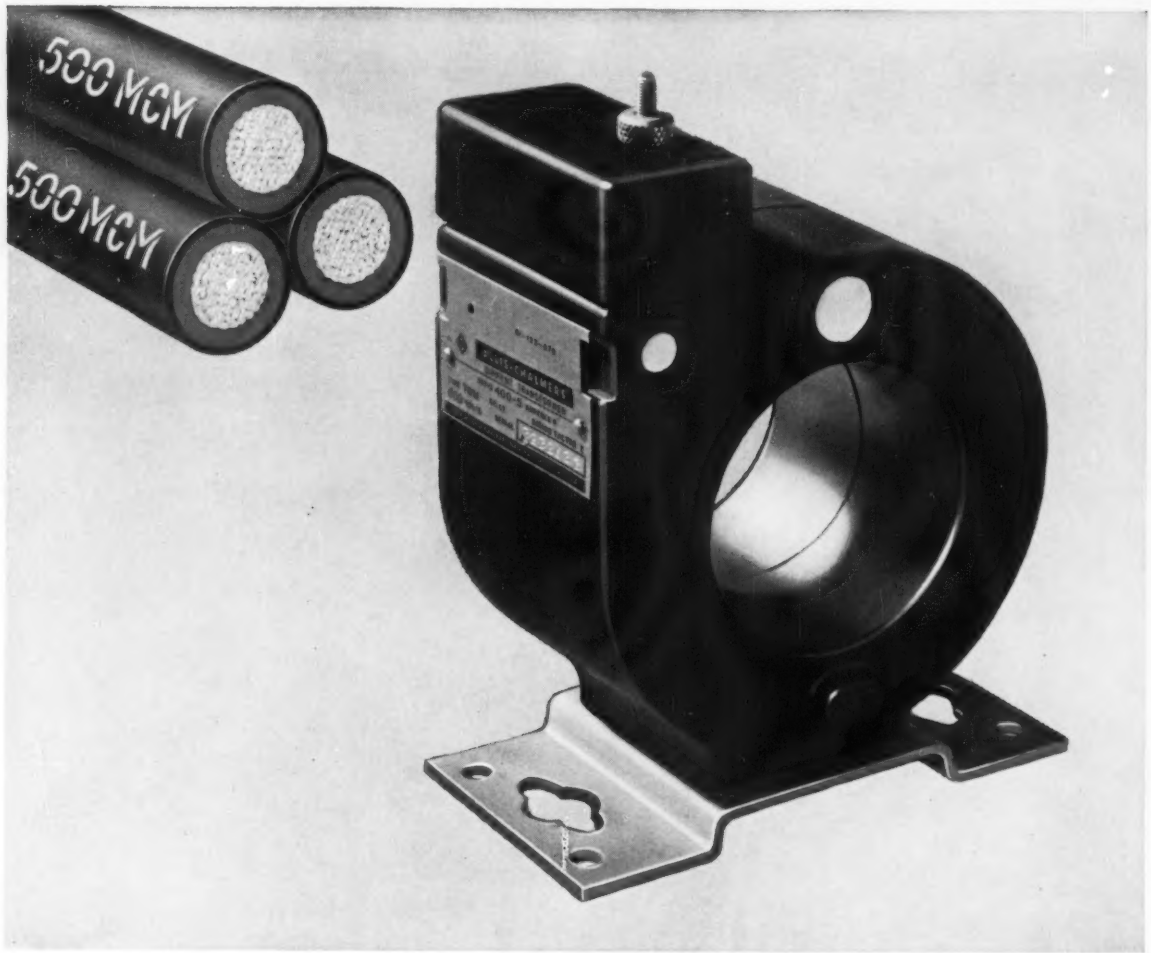
ALLIS-CHALMERS



Lightest weight with largest window

and the best accuracy available on the market today

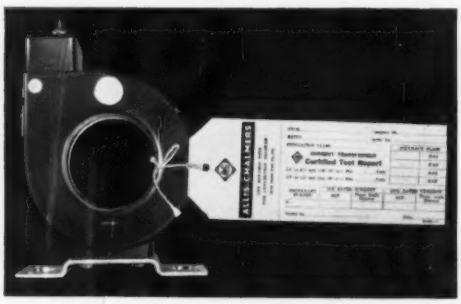
The NEW Allis-Chalmers "PICTURE WINDOW" current transformer can easily take three 500 MCM cables.

Compact, easy to install, indestructible and weatherproof — this 600-volt epoxy-resin transformer will withstand wide temperature variations and the most severe mechanical shocks. Eliminates all possible maintenance.

Easily adapted for conduit-type hookup, A-C current transformers can be used on 2 or 3-wire, single and polyphase circuits. Ratings: 200, 400, 600 and 800 amperes.

Get full details on this NEW TWM current transformer from your nearby A-C office. Or write ***Allis-Chalmers,*** *Power Equipment Division, Milwaukee 1, Wisconsin.*

A-1310



Verified accuracy! Certified test card accompanies every A-C unit shipped. This A-C design provides ample overcurrent capacity without reduction of accuracy.

Electrical World

Vol. 154, No. 5 AUGUST 1, 1960

Published for 86 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

In This Week's Issue

CURRENT EVENTS

English Channel Cable Gets Another Push

Contracts let for British half of international 160-Mw submarine tie ..... p 28

DISTRIBUTION

Demand Grows for Standards' Revision

Martin F. Beavers, General Electric Co

Buyers seek transformers of greater short-circuit capability, feel present test standards are unrealistic..... p 34

GENERATION

28-Mw Advanced Gas-Cooled Reactor Built

British reactor at Windscale is the prototype of a 500-600-Mw unit planned for an industrial area site..... p 38

MANAGEMENT

Plan for Future Land Use

Cleveland Electric Illuminating Co will furnish a comprehensive long-range land-use study to local communities... p 57

SYSTEM ENGINEERING

Load Flow Study Has Speed, Flexibility

G. W. Stagg, E. L. Wizemann, AEP Service Corp

AEP Service Corp computer program successfully simulates interconnected system operation in load flows solution..... p 30

TRANSMISSION

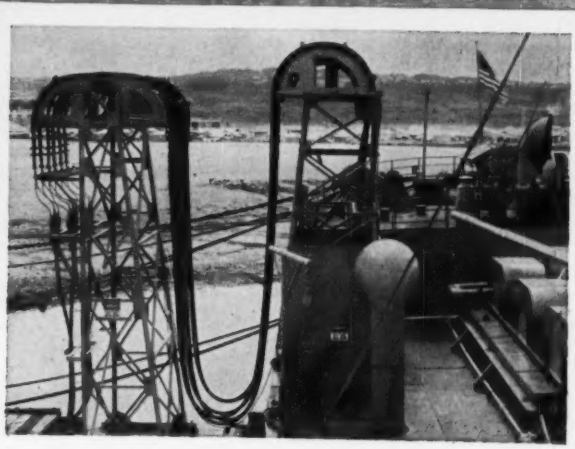
Swedish Develop 280-Kv Guyed Towers

O. D. Zetterholm, L. O. Berg, Swedish State Power Board

Construction for 600-mile extension adds conductor per phase, yet is light enough to promise 31% steel saving..... p 36

Departments

Editorial Comment 23
Electric Utility Methods..... 40
Electrical Week 11
Executive Reader 14
Letters 5
Management Newsletter.... 57
Manufacturers News 46
Meetings Calendar 80
New Equipment 52
News About People..... 72
Politics and Public Power... 12
Procurement & Products.... 44
Selling 65
Today's Design Trends 42
INDEX TO ADVERTISERS... 80



20,000 KW OF POWER, ON A STANDBY BASIS, are always reliable from the floating power barge Jacona, anchored off the island of Okinawa. Okonite cables form the ship-to-shore link. The permanent Okinawa generating system provides power for normal requirements. However, reliable standby generation is required for scheduled and unscheduled equipment outages. As a result, the dependable Okonite cables have frequently been pressed into service. Gilbert Pacific, Inc., subsidiary of Gilbert Associates, Inc. of Reading, Pa., which operates the generating and transmission system for the U. S. Army, reports service to date—from 1956—has been perfectly satisfactory.

Cable'bility at work

Backstop for Okinawa power supply

Cable'bility (cā'ble·bil'·i·ty) *new word. Noun.* **1.** Ability to design and manufacture electrical cables that give outstanding performance. **2.** Having long background and wide experience in cable research and application. **3.** Possessing keen understanding of customers' problems. Implies eagerness to serve faithfully and dedication to progress. **Syn.** The Okonite Company.

Standby power for the entire island of Okinawa is generated on a floating barge and flows at 13.2 kv through six 80-foot lengths of Okonite cable. Constructions used are 1/c, 1,000 MCM, strip-insulated, extra-flexible cables, complete with factory-made stress cones and terminal fittings. Since the cables have a large, air-suspended loop, they have a seine twine reinforcement within the extra-heavy Okoprene sheath for increased longitudinal strength.

Use of Okoprene spotlights its unusual protection against weather, chafing, constant flexing, heat and cold, acids, alkalies and chemical attack. The installation itself provides an excellent demonstration of how unusual cable problems are solved by Okonite Cable'bility.

If you have a difficult cable job in mind, get in touch with Okonite. Let us help you *now* . . . while you're in the planning stages. Applying Cable'bility, we might have an idea that will make the whole job easier, surer and longer lasting. The Okonite Company, Subsidiary of Kennecott Copper Corporation, Passaic, N. J.

***where there's electrical power . . . there's* OKONITE CABLE**

6910-A

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LETTERS

Lighting Report—A Fine Job

To the Editor:

Confirming our telephone conversation of this morning, we should like once more to compliment you on your very fine article, "Living with Light" in this week's (July 18) issue of *Electrical World*.

. . . We would . . . like to have 200 copies of the 12-page reprint at your earliest convenience. . . .

G. Lanson
Holophane Co, Inc
342 Madison Ave
New York 17, N. Y.

▶ *Thank you, Reader Lanson. Your reprints are on the way.*

Pad-Mounteds Are Available

To the Editor:

A printing error occurred in the article, "Distribution to Trailers Can Be Open Wire or Underground," appearing in the June 13 issue of *Electrical World*. The second sentence of the last paragraph of the second column (p 54) should read, "The pad-mounted transformer now commercially available. . . ." As printed, the phrase "not commercially available" is certainly an error of fact.

During the last few years transformer manufacturers have been most cooperative in the development and production of pad-mounted transformers to meet consumer demands.

E. C. DeBaene
Line Standards Engineer
The Detroit Edison Co
Detroit 26, Mich.

▶ *We appreciate your pointing out this obvious slip, Reader DeBaene. Other stories in our magazine and a host of advertisements attest to the availability of such transformers.*

No Reflection on Loyalty

To the Editor:

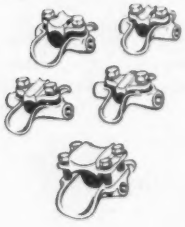
On page 54 of the July 11 issue, the article on the Energy Forum held recently at American University quotes me as referring to the views of Mr Alex Radin, American Public Power Assn, as enthusiastic about Russian power developments and less so on United States development.

While I do not have my precise language, the implication in this report seems to reflect on the loyalty of Mr Radin, which, of course, was not my intention, nor do I believe there was any basis in what I said for any such reflection. I was disappointed in not having him present after I had understood he would be one of the participants.

Willard W. Gatchell, General Counsel
Federal Power Commission
Washington 25, D. C.

CLAMP

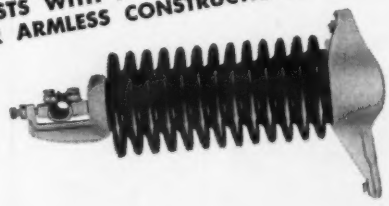
THE LAPP CLAMP IS INTERCHANGEABLE



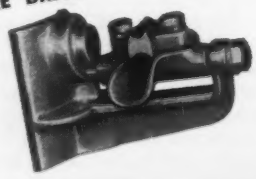
Five sizes of clamps, in aluminum or malleable, each with reversible keeper, provide correct fit for all conductor sizes .25″ to 2.00″ dia. All clamps are interchangeable for use on

CLAMP-TOP LINE POSTS . . .

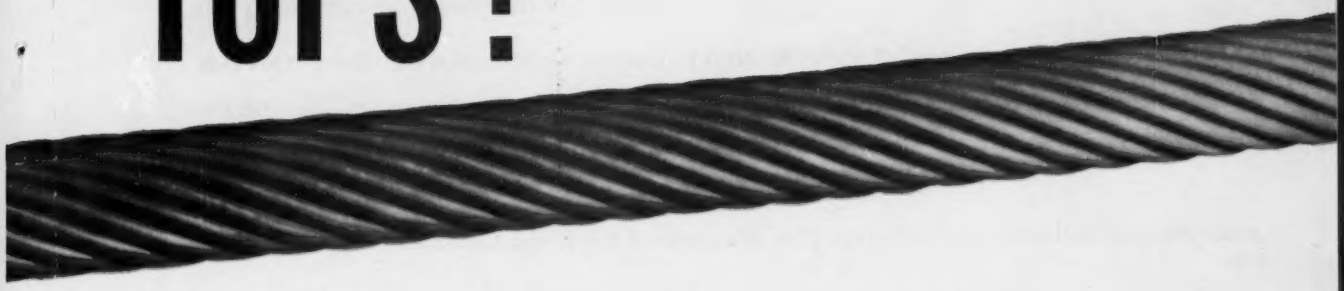
CLAMP-TOP LINE POSTS WITH INTEGRAL BASE-AND-GAIN FOR ARMLESS CONSTRUCTION . . .



CLAMP-TOP GROUND-WIRE BRACKETS



-TOPS?



THE LAPP CLAMP IS EASIEST TO INSTALL

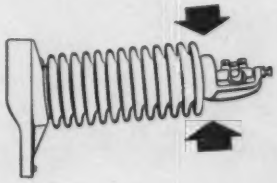
For original installation, insulator (or bracket) with clamp attached, is mounted to crossarm or pole. Keeper cap screws are loosened, and one removed. With keeper rotated out of position on remaining cap screw, conductor is dropped into place. Keeper is brought back to position, cap screw replaced, and both cap screws tightened. Cap screws have captive lock-washers so there is *only one loose part* per insulator throughout installation.

THE LAPP CLAMP IS EASIEST TO WORK WITH HOT-LINE TOOLS

No special tools required for insulator change-out. A trunnion cap screw is merely backed off, and conductor (with clamp attached) lifted out of position. The same clamp will slip into position in a replaced insulator and be secured by tightening trunnion cap screw. *No loose parts* throughout insulator change.

THE LAPP CLAMP-TOP IS MOST DEPENDABLE

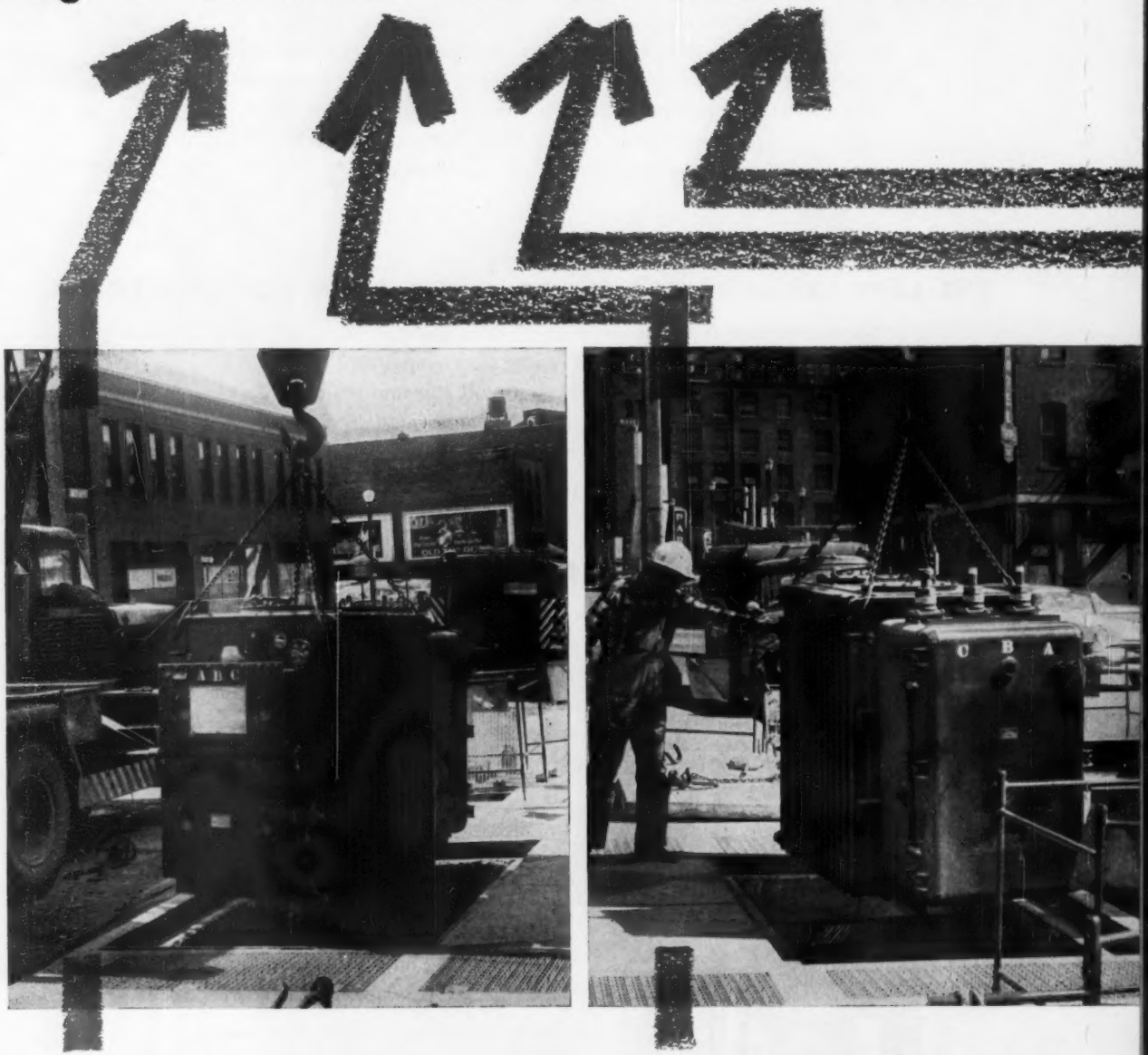
A principle of Lapp Post design is the *external* attachment of hardware—*bases and caps*. This assures that the porcelain body be loaded only in large-area low-intensity compression. This design takes full advantage of porcelain's superior compression strength, and provides an assembly greatly more secure than one subject to the high-intensity tension loading introduced by internal pins and inserts.



Lapp

For new ideas on economical, efficient line and station construction read the new Lapp Catalog Eight. For your copy, write Lapp Insulator Co., Inc., Le Roy, N. Y.

Regular dividends from this hidden asset...



The installation of this rugged, compact Moloney Network Transformer will provide the utility installing it with regular dividends for many years. Moloney thoroughly analyzed network operational problems to develop the advanced design and construction which make this transformer a valuable hidden asset.

Advanced Design Features That Yield Dividends . . .

• Compact size resulting in smaller vaults • Corrugated tank walls to reduce maintenance and facilitate reconditioning • High overload capabilities • Grouped accessories for operational simplicity

Give your system the advantage of this hidden asset . . . Specify Moloney Network Transformers.

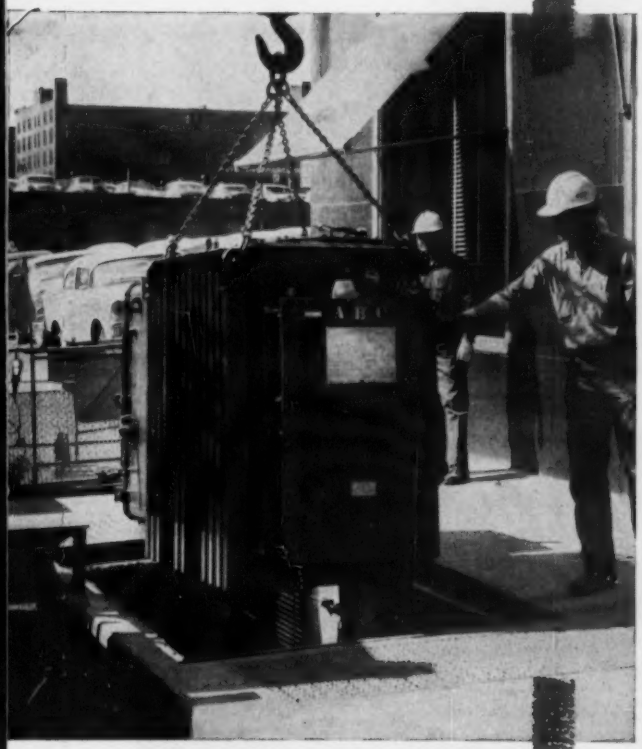
MEGO-19

MOLONEY ELECTRIC COMPANY

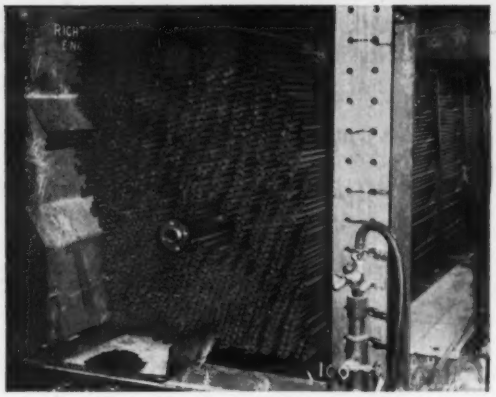
Transformers for Utilities, Industry, and Electronics

FACTORIES: ST. LOUIS 20, MO., AND TORONTO, ONT., CANADA

Sales Offices In All Principal Cities



New Dickerson Station of Pepco equipped with over 170 miles of Phelps Dodge Condenser Tubes!



The newest power station of the Potomac Electric Power Company at Dickerson, Md., fills a big need for increased electric power in the greater Washington, D.C., area. The plant's two mammoth generating units, each with a capacity of 175,000 kilowatts, boost PEPCO's total electrical capacity by nearly one-third.

Within the giant condensers of the units are more than 170 miles of Phelps Dodge Admiralty and Cupro-Nickel condenser tubes weighing over a half-million pounds. These tubes were specified because of their record of proven dependability and long service life in similar operating conditions.

In every industry that uses heat transfer equipment, Phelps Dodge tubes are known for their lasting quality. This reputation has made Phelps Dodge a leading fabricator of copper and copper-alloy tubes for the manufacturers of condensers and heat exchangers.

PHELPS DODGE COPPER PRODUCTS
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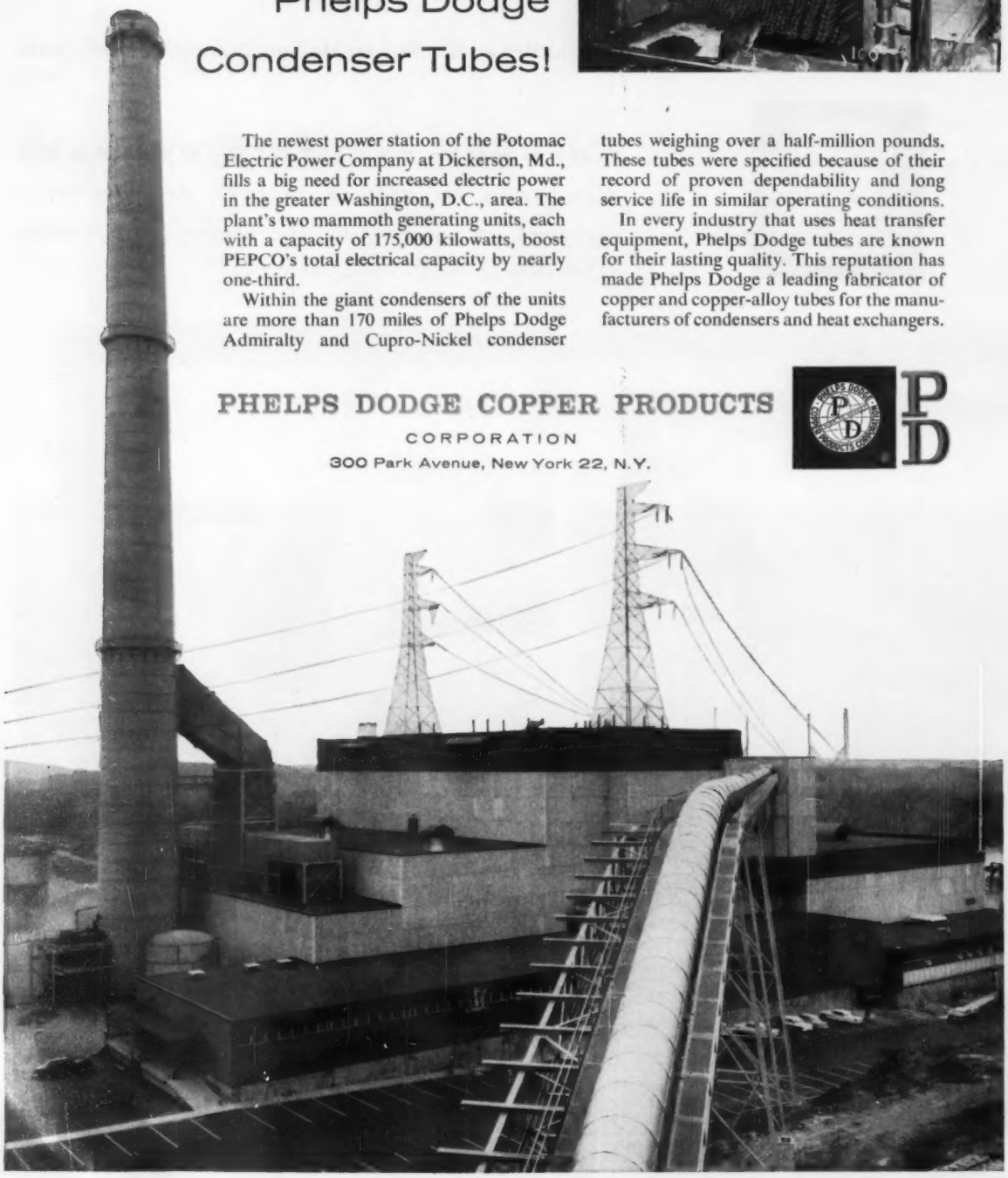


The Electrical Week

FUTURE NEWS ▶ **Insiders say Federal Government may soon build** a 345-kv transmission line from BPA to Missouri Valley and tie with four new 500-Mw steam plants.

LATE NEWS ▶ **Prices of 14.4 to 345-kv switchgear were reduced** up to 50% Aug. 1 by GE. Average reductions from last published prices (withdrawn Nov. 17, 1959) are: distribution circuit breakers, 40%; subtransmission OCBs, 30%; transmission OCBs, 33%; isolated-phase buses, 20%; indoor cubicle equipment and cell-mounted breakers, 15% (more changes on p. 26).

Black Hills P&L takes over the electric properties of Central E&G in the towns of Hot Springs, Buffalo Gap and Oral, and rural areas.

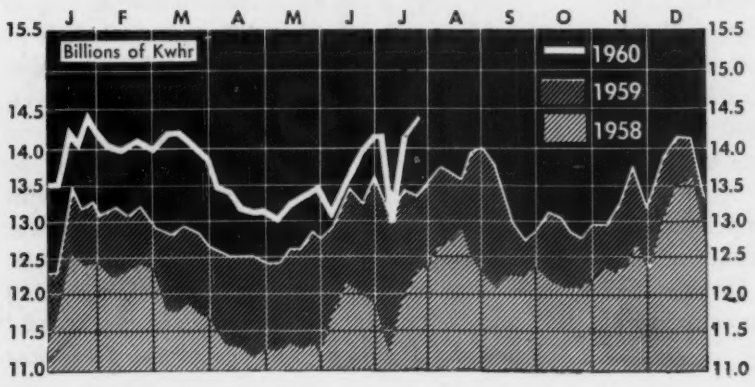
Federal Pacific Electric acquires Pioneer Electric Ltd (Canada) for about $5 million in cash and stock.

Around the states . . . Philadelphia Electric asks AEC for construction permit to build 40,000-kw atomic plant at Peach Bottom, Pa. . . . Ohio Ed and Joint Council of Utility Workers agree to two-year pact. Raises amount to 6 to 13¢ an hour for first year and 5½ to 14¢ in the second year. IBEW turns down a similar offer . . . Glasgow, Ky., renews fight for a municipal power plant. Citizens will vote on proposals in November. Kentucky Utilities would lose out to TVA on service.

Regulation . . . Central Hudson G&E cuts residential rates by $220,800 a year for consumption in excess of 400 kwhr monthly. Reason: to encourage use of water and space heating . . . League of Iowa Municipalities survey shows a 2-1 ratio favoring a public utilities commission. In past survey showed 2-1 against a commission.

Management changes . . . Union Electric elects G. P. Gamble and A. H. Schettler executive vps. Dudley Sanford, executive vp, will retire Nov. 1 . . . Upper Peninsula Power names R. F. Hoyer administrative vp.

WEEKLY POWER OUTPUT—UP 6.2% (Week ending July 23), Kwhr 14,425,000,000



Per Cent Change From Previous Year

	July 9	July 16	July 23
Total U. S.....	— 3.5	+ 5.9	+ 6.2
New Eng.	— 4.3	+ 4.2	+ 2.1
Mid. Atlan.....	— 6.2	+ 7.0	+ 1.7
Cent. Ind.	—10.5	+ 1.3	+ 5.1
West Cent.....	— 4.8	+10.3	+10.8
Southeast	— 1.7	+ 6.0	+ 6.8
South Cent.	+ 4.9	+12.7	+ 8.2
Rocky Mount...	+ 2.7	+ 6.2	+ 5.7
Pacific			
NW	+ 2.0	+ 6.8	+ 5.6
SW	+ 1.6	+ 5.7	+12.9

Seasonally Adjusted Index 269.2

Week ago 271.2 Year Ago 251.6

Source: Edison Electric Institute

Preview of This Issue

EVENTS ▶ **An Electrical World reporter talks to Republican platform** writers and witnesses in pre-convention sessions. Sherman Knapp presents investor-owned utility views and Harry H. Nuttle and Charles A. Robinson Jr present NRECA recommendations **(p 24)** . . . Power Reactor Development Corp and Atomic Energy Commission plan appeal of Enrico Fermi safety shutdown to US Supreme Court as Circuit Court of Appeals denies re-hearing petition **(p 26)** . . . Florida Power & Light Co gets notice of rate investigation from Railroad & Public Utilities Commission. Rumors of statewide investigation are not borne out by interviews **(p 26)** . . . Britain and France to build 200-kv cable under English Channel to take advantage of different peak loads with interconnection **(p 28).**

ENGINEERING ▶ **Boosted speed, flexibility of load flow study** results from successful simulation of interconnected system operation in a computer program developed by AEP Service Corp **(p 30)** . . . Buyers want distribution transformer standards revised to provide for units of greater short-circuit capability **(p 34)** . . . Swedish State Power Board develops new type of 380-kv guyed towers **(p 36)** . . . Britain's 28-Mw Advanced Gas-cooled Reactor at Windscale is prototype of a 500-600-Mw unit planned for an industrial area site **(p 38).**

Politics and Public Power

NEW FPC MEMBER TAKES OVER

Paul A. Sweeney, 65, has taken over the job of federal power commissioner with considerable doubt about how long he will hold it, but with certainty that, as long as he does, he will strive "to regulate impartially."

Sweeney, now serving under a recess appointment, has some 35 years of experience as a government lawyer, including stints with the Civil Service Commission and the State Department, and 30 years with the Justice Department.

When Pres Eisenhower appointed him to the FPC this spring, Sweeney had been first assistant in the Justice Department's Office of Legal Counsel for two years.

"I'm just a career government lawyer with a hell of a lot of career in it," Sweeney says.

In the office of legal counsel, Sweeney frequently worked on electric power and natural gas cases from the FPC.

This work involved FPC cases appealed to the federal courts, or cases in which courts had ruled against the Commission, and the government was considering further appeal.

"You can see," Sweeney says, "that I'm not unfamiliar with the work of the FPC, and this experience is making it easier for me to catch up."

One appealing thing about FPC service, Sweeney says, is the opportunity to get his own views into Commission opinions.

He recalls working diligently in behalf of decisions from the FPC, and other agencies, that he didn't agree with, and now he welcomes a more judicial role.

Sweeney believes that Congress and the courts have made all the basic decisions about the extent of regulation in the electric power and natural gas fields.

The Commission isn't a policy-making body so far as these decisions are concerned," he says. The Commission's job involves "how

PROCUREMENT & PRODUCTS ▶ **A 5% price increase on distribution insulators** is announced by Ohio Brass . . . RT&E holds firm on 55C rise and single transformer ratings, following uprating by four manufacturers (p 44) . . . California Electric Power Co gets two-winding, 20-Mva, 3-phase mobile transformer . . . Alcoa develops new use for aluminum electrical bus conductors . . . Salt mine uses nearly 60,000 ft of rigid aluminum electrical conduit (p 46) . . . Disconnect switch is designed for horizontal mounting between bus support and circuit breaker bushing in outdoor substations . . . Spacer for bundled transmission conductors provides column strength, flexibility . . . Light-weight deadend insulator is developed (p 52).

MANAGEMENT ▶ **How can a utility help a community** plan and grow without seeming to interfere? CEI has made the attempt, providing northeast Ohio communities with a comprehensive long-range land-use study. See page 57 for details.

SELLING ▶ **West Virginia builder sells 180 Gold Medallion** homes in a highly competitive area with gas resources. To find why the builder feels heat pumps are requisite, please turn to page 65.

NEXT WEEK ▶ **Don't miss EW's 16-page substation design report.**

to regulate," he says, "and I approach this job with no prejudices as to how to regulate."

For example, he disclaims any hard-and-fast views on public vs private power.

He says any case presenting this issue must be decided on its own merits, but "ultimately the public interest controls."

The public interest to Sweeney is broader in some circumstances than the immediate consumer interest, and he says there may well be other factors to be considered beyond "the lowest rates for consumers," such as how quickly electric service can be started.

Sweeney's first two weeks in office have included briefings by FPC staff experts and the other three commissioners on broad FPC problems and issues.

With this indoctrination, he has also been busy meeting lawyers and representatives of various segments of the industry, including many on Justice Department cases.

Sweeney has no fears that a policy of remaining accessible will mar his impartiality.

His years as a career government lawyer, he says, have taught him how to deal with efforts to exert improper influence, and he notes that such efforts seldom, if ever, come from lawyers.

With the briefings and the visits, Sweeney also has a desk littered with congratulations. "After a couple weeks of this initiation, I'll get my head above water," he says, but predicts, "The desk will always look like this."

Sweeney was appointed to fill the unexpired term of the late John B. Hussey, ending in June, 1963.

However, Senate Democrats are refusing to confirm his appointment so that if Sen John F. Kennedy wins the White House in November, he will be able to name his own man.

Sweeney says he has no promise from Vice President Richard M. Nixon to continue him in office if Nixon becomes president, and he has no idea what Kennedy would do.

Executive Reader

Wage costs in Western Europe vary widely, not only from country to country, but also from industry to industry. They are still far below US levels, however. The US averages of $2.68 for manufacturing industries compares with $1.08 for Sweden, the highest, and 57¢ for the Netherlands, the lowest in Western Europe. **Report on Western Europe, The Chase Manhattan Bank, June-July, 1960.**

With emphatic rejection of cooperative Canada-US development of the Passamaquoddy by the International Joint Commission as too costly, attention has increased on the Shepody-Cumberland Tidal Power scheme—an all-Canadian project. Besides being entirely Canadian, it is estimated to cost $205 million as against $532 million for Passamaquoddy. **Tides, the Key to Maritime Power? Arthur C. Northover, Electrical Digest, June, 1960.**

The dependence of the utility industry on coal should continue to grow as our nation's energy needs expand. The utilities, therefore, should consider a healthy coal industry as a prime requisite of their future. They should do everything within their power to make coal as prosperous as possible. The great responsibilities imposed upon them as champions of free enterprise require that growth of the coal industry be sustained and even expanded. **Coal and Electricity—Doing a Job Together, United Mine Workers Journal, July 1, 1960.**

Establishment of an Institute for the Certification of Engineering Technicians and Engineering Technologists has been approved by the Board of Directors of the National Society of Professional Engineers. A. C. Friel, Midland, Mich., chairman of the National Society's Committee on Engineering Technicians, said that the establishment of the Institute "should provide a much needed means of recognizing the status of technician members of the technological team."

A new theory to explain the rusting of iron has been developed by Westinghouse research scientists Dr Earl A. Gulbransen and T. P. Copan. The culprits causing rusting are said to be hydrogen ions, or protons. The theory suggests that the tiny hydrogen particles penetrate the iron and enlarge the sites at which oxygen normally combines with the metal. This spreads the reaction throughout the surface of the iron, causing it to rust destructively.

Detergents for removing radioactive contamination are being used by the English Atomic Energy Authority. One detergent is reported to remove even radioactive contaminants chemically bound to working surfaces or clothing.

"I learned more about suspension insulators in the past 25 minutes than I've learned in the past 25 years!"

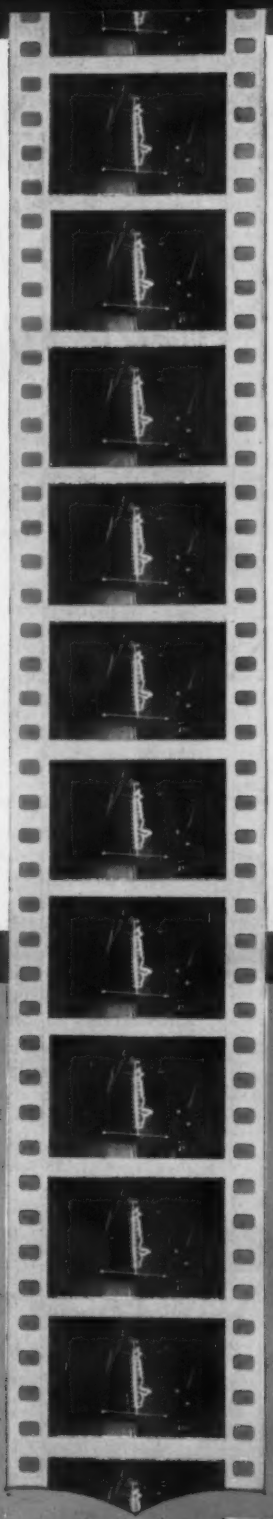
"The Second 50 Million" is the story of a modern suspension insulator - - how it is designed, manufactured, tested, and applied to meet the requirements of modern high-voltage transmission.

It explains how the industry's most advanced research and design tools probe into tomorrow's insulation problems; how laboratory and field service experience has modified insulator design to achieve greater efficiency, strength, and durability. It shows the most modern production line in the industry producing the industry's most modern suspension insulator. And it recreates the dramatic - - the sometimes grueling - - tests that "prove out" modern insulator design.

Highly informative, timely, interesting - - "The Second 50 Million" offers every utility man the opportunity to review today's achievements in the development of insulation for high voltage transmission lines.

Call your O-B representative to arrange a showing soon in your own office . . . at your convenience.

OHIO BRASS COMPANY, MANSFIELD, OHIO



"The Second 50 Million"

A Sound-Color Motion Picture Film By OHIO BRASS

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PORCELAIN INSULATORS • LINE HARDWARE • CAPACITORS • LIGHTNING ARRESTERS
BUSHINGS • HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES • BRONZE VALVES

10028-H

HOW SOUTHERN STATES' BV-33-F CUTOUT CLEARS RESTRICTED OR HIGH FAULTS WITH EQUAL DEPENDABILITY

The complexities of today's distribution systems present a real challenge to the designers of cutouts. Industry requirements call for interrupting capacities up to three times higher than a few years ago. And yet the cutout must clear restricted faults with equal ease and sureness.

Large bore tubes, vented freely at both ends, will clear extremely high faults easily. Small bore tubes, vented at one end, will clear low faults easily. The big problem is to do both.

The Southern States BV-33-F Heavy Duty Cutout clears the complete range of fault currents with equal dependability—without damage to the cutout.

What About Single-Venting?

In single vented cutouts, the rocket effect of the tube, as gases are ejected, must be considered. Some type of shock absorber to cushion the fuse holder, as it tends to thrust upward, must be provided. But so far no practical recoil mechanism has been devised that can fully absorb the violent recoil action. Thus a substantial amount of shock is transmitted to the mounting, insulator, bracket, and cross arm.

As interrupting capacities on single-vented cutouts are increased, bore diameters become critical. If it is large enough to handle high faults, it may provide only borderline protection on restricted faults. Resorting to some extraneous means, such as special types of fuse links, is a dangerous concession to security—as there is no assurance of proper fusing in the field.

What About Controlled Venting?

Providing a small vent hole in the top hardware to permit a limited amount of gas to escape is not the solution either. This practice was dropped by Southern States long ago, when it was found that the hole became enlarged after each operation, endangering proper clearance of low faults.

Here's the Answer

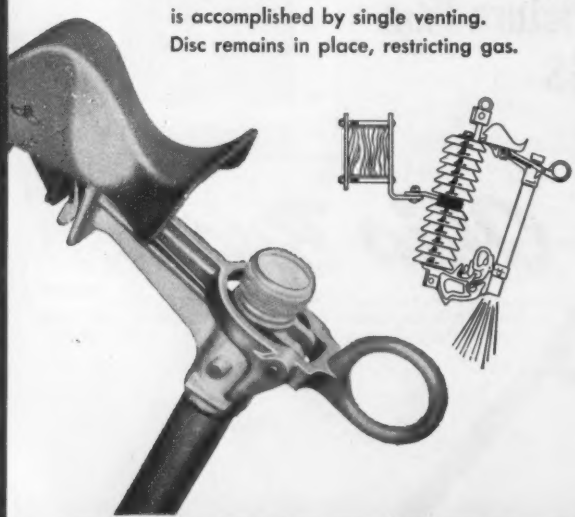
The BV-33-F offers all of the advantages and none of the disadvantages of single-venting or controlled-venting. This is accomplished with an economical expendable cap which confines gases on restricted faults, but allows them to double vent on high faults. Forces inside the tube are equal and opposite. Stress on the mounting is virtually eliminated. The cutout can operate time and time again without loss of efficiency. There is no built-in battering ram—no intricate mechanism, or springs to worry about. And any standard EEI-NEMA fuse link will provide positive operation every time.

Utilities throughout the nation are finding the BV-33-F a practical, workable solution to cutout problems.

Get complete information from your Southern States representative, or write for Bulletin 580C.

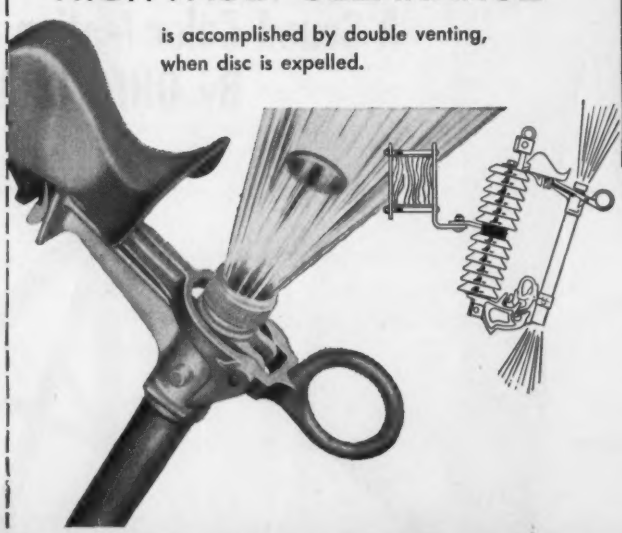
LOW FAULT CLEARANCE

is accomplished by single venting.
Disc remains in place, restricting gas.



HIGH FAULT CLEARANCE

is accomplished by double venting,
when disc is expelled.



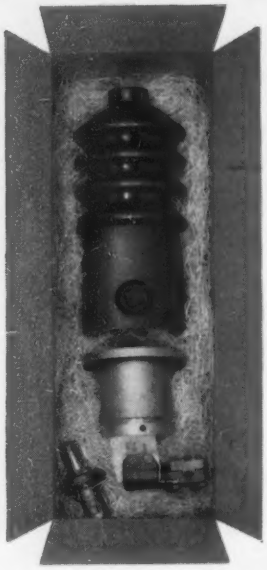
SOUTHERN STATES EQUIPMENT CORP.

HAMPTON, GEORGIA

IN CANADA Dominion Cutout Co., Ltd., Toronto

UNIT PACKAGING

IMPROVES DELIVERY; CUTS INVENTORY AND COSTS!



A standard capnut pothead ready for shipment as a typical unit package.

All components and oil for three, gang-operated oil-filled cutouts are shown in this typical unit package.

G&W's unique Unit Packaging program saves you time and money. Every component, device, and accessory required for the installation of a G&W standard Pothead or oil-filled Cutout is quickly gathered from "off-the-shelf", carefully and securely packaged, and sent to you *complete* in a single carton or crate. Once put into your inventory, it is a simple matter to take from stock as many individual boxes as required, load on a line truck, unpack right at the job site, and put the units into service in short order. You not only effect substantial savings on inventory control and handling, but materially cut installation costs.

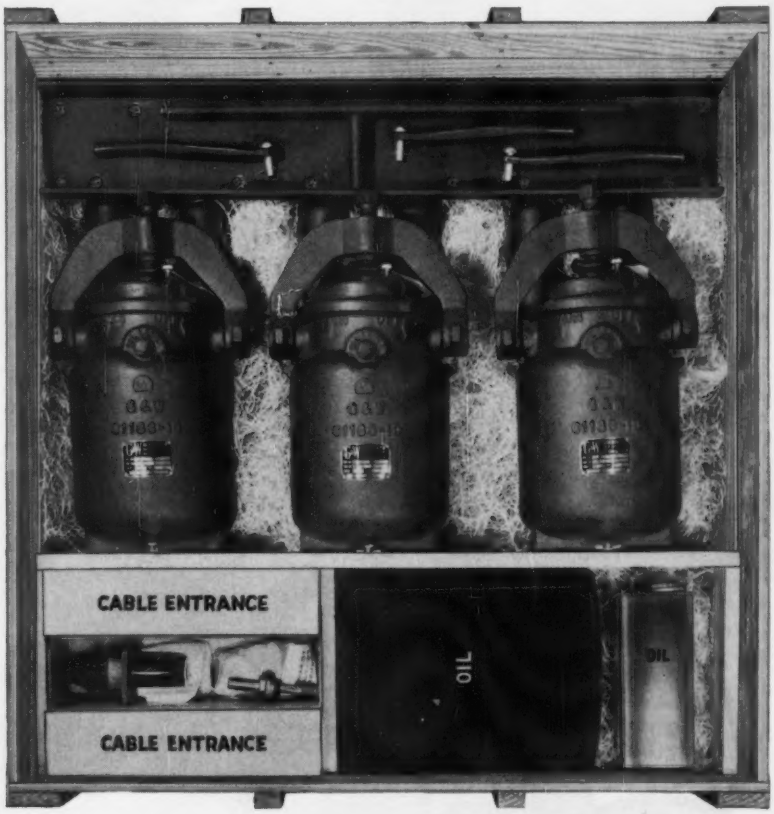
Unit Packaging is another benefit you gain from G&W's constant development of cable accessories and switchgear. Further proof, too, that you are dollars ahead by relying on G&W's 55-year record of dependability and quality. A G&W representative will assist you in solving any cable accessory or switching problem, or write us for full detailed information.

G&W ELECTRIC SPECIALTY COMPANY

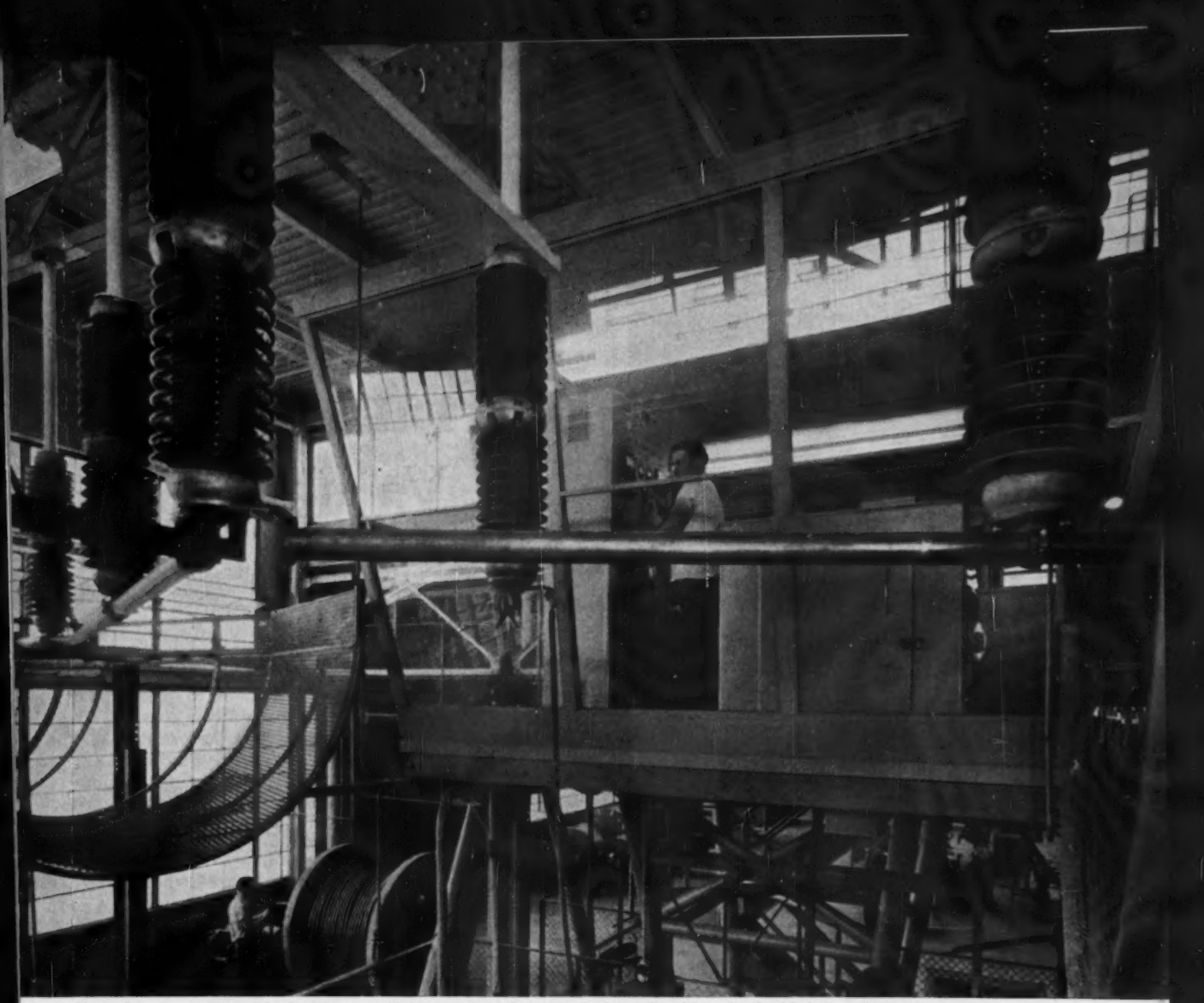
3500 West 127th Street, Blue Island, Illinois

CANADIAN MFR. • POWERLITE DEVICES, LTD. • TORONTO, MONTREAL & VANCOUVER

superior quality standards – inspired specialized design



G60-2



Shown here is a section of final testing area. Voltage tests are being applied to *full reel lengths* of cable before shipment.

ANOTHER BIG REASON WHY YOU SHOULD CONSIDER ANACONDA BUTYL (AB) CABLE—

SPECIALIZED QUALITY CONTROL AND INSPECTION

From the start: Raw-material suppliers are required to submit certified test reports. Then, tests and sampling at our plant offer extra protection even before production begins. **To finish:** Here's the final inspection line where the finishing touches are applied and where every inch of cable is carefully inspected. Perhaps you already know that Anaconda test procedures are much above industry standards. But do you know that test voltages on Anaconda Butyl (AB) Cable are 125% of industry standards—that minimum corona level is 150% of rated voltage to ground?

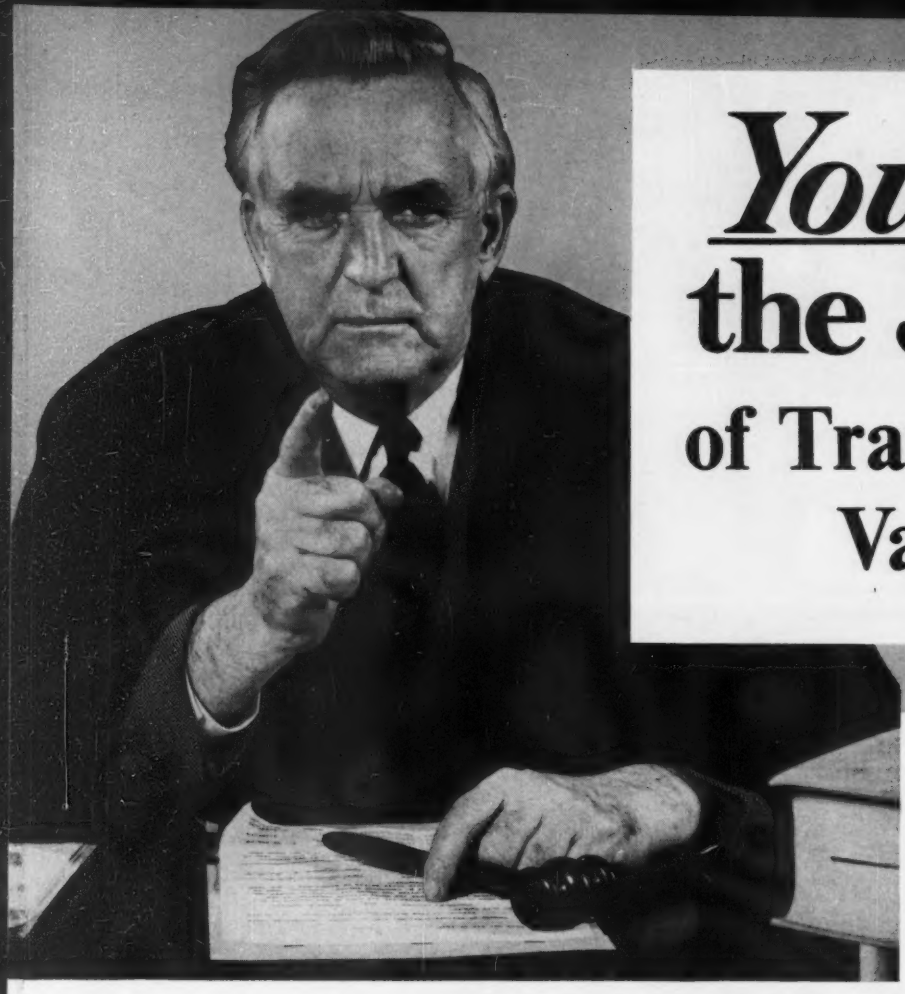
Quality control at Anaconda is *more* than mere testing and inspection. It is built into every manufacturing step. That's why you can be sure your Anaconda cable will be of high quality—why you can be sure Anaconda Butyl (AB) Cable is the finest rubber-insulated cable you can buy.

Everything you need to know about Anaconda Butyl (AB) high-voltage cable is neatly summed up in a new booklet, DM-5903, "Anaconda High-Voltage Durasheath* Cable." For your copy, write to: Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y. *Reg. U.S. Pat. Off.

ASK THE MAN FROM

ANACONDA®

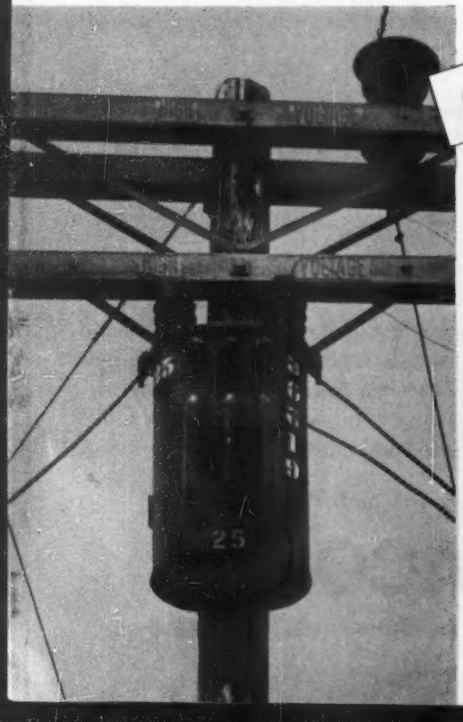
ABOUT BUTYL (AB) HIGH-VOLTAGE CABLE



You be the Judge of Transformer Values

Your Line Material Field Engineer is anxious to present the Round-Wound case to you. He has overwhelming evidence that will prove to you beyond a shadow of a doubt that Round-Wound transformers can be uprated more safely than any competitive design.

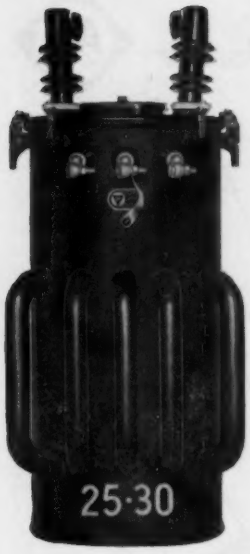
UPRATE THE L-M ROUND-WOUNDS

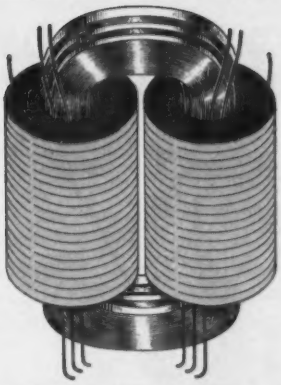


ON YOUR POLES

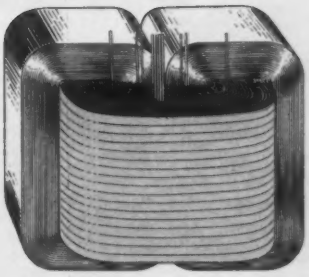
...IN YOUR STOCKS

L-M's exclusive Round-Wound design enables you to uprate all L-M transformers purchased during the last two years. Thus, all L-M transformers bearing serial number 1,700,000 or above on your lines or in your stocks can be uprated as announced.





L-M transformers exclusively incorporate a core-type core-and-coil design, designated Round-Wound®. It is a continuously wound single core with coils wound directly on each leg. This exclusive design, illustrated by the color area, permits oil ducts to be concentric about the entire winding. Maximum winding area is exposed to oil for rapid and efficient cooling. For any given loading, Round-Wound transformers have considerably lower hottest-spot temperatures and therefore greater life expectancy.



Every major manufacturer of competitive transformers utilizes a shell-type core-and-coil design. Oil ducts, illustrated by color area, can not be placed in the portion of winding under the cores. Heat is trapped and hottest-spot temperatures build up. Circulating oil can not get to these spots to carry the heat away. Result: oil stays fairly cool, while windings sizzle. Insulation deteriorates most rapidly in these areas, with an appreciable reduction in transformer life.

Uprate L-M Round-Wound® Transformers Without Any Loss of Life Expectancy

All L-M Round-Wound transformers, serial number 1,700,000 or above (serial number 7,006,650, Visalia, California production), can be safely uprated. This uprating applies to transformers now in service or in your stocks. It includes all L-M transformers produced within the last 2½ years. Only L-M can safely offer this unprecedented uprating because of the exceptional cooling characteristics of the Round-Wound core-coil construction. You get the following bonus uprating on Round-Wound transformers:

20% bonus: 5-15 kva, through 16,340 volts
20% bonus: 25 kva, through 8,000 volts
12% bonus: 25 kva, 12,000 through 16,340 volts
12% bonus: 37½-100 kva, through 16,340 volts
5% bonus: 167 kva, through 16,340 volts

Increased transformer loading and decreased transformer life expectancy are closely related. As over-loading increases, transformer insulation breaks down, jeopardizing transformer life expectancy.

Average winding temperature can be partly indicative of the damaging effects loading has upon transformers. Hottest-spot temperature, however, the maximum temperature within a transformer winding, is the one sure indicator of potential winding failure. If the hottest-spot or maximum winding temperatures are held within safe limits, winding insulation is not jeopardized and normal transformer life expectancy is maintained.

Only the Line Material exclusive Round-Wound design can effectively cool the entire winding, eliminating extreme hottest-spots. Round-Wound core and coils have concentric cooling. The oil is free to circulate through the entire winding. There are no cramped areas, no extreme hottest-spots in Round-Wound design. That is why Round-Wound transformers, without re-design, can confidently be uprated —higher than any competitive design.

You can uprate Round-Wounds without exceeding the present ASA-NEMA standard of 65°C allowable maximum rise in winding hottest-spot temperature. And the uprated transformers carry the full L-M transformer guarantee.

The present design of Round-Wound transformers have been in production for over two years. Thus, the Round-Wounds on your system, in your warehouse, as well as those you buy tomorrow, have bonus capacity and may be confidently uprated.

See your L-M Field Engineer. Let him present all the logical evidence. Then . . . YOU BE THE JUDGE.

You BE THE JUDGE!

- This is one of a series of advertisements in which Line Material is presenting facts on distribution transformers.
- In other advertisements, and through calls by our Field Engineers, L-M will present additional evidence for your consideration.
- All we ask is that you listen to the facts, and weigh the evidence.
- Then YOU BE THE JUDGE of the real values in distribution transformers.

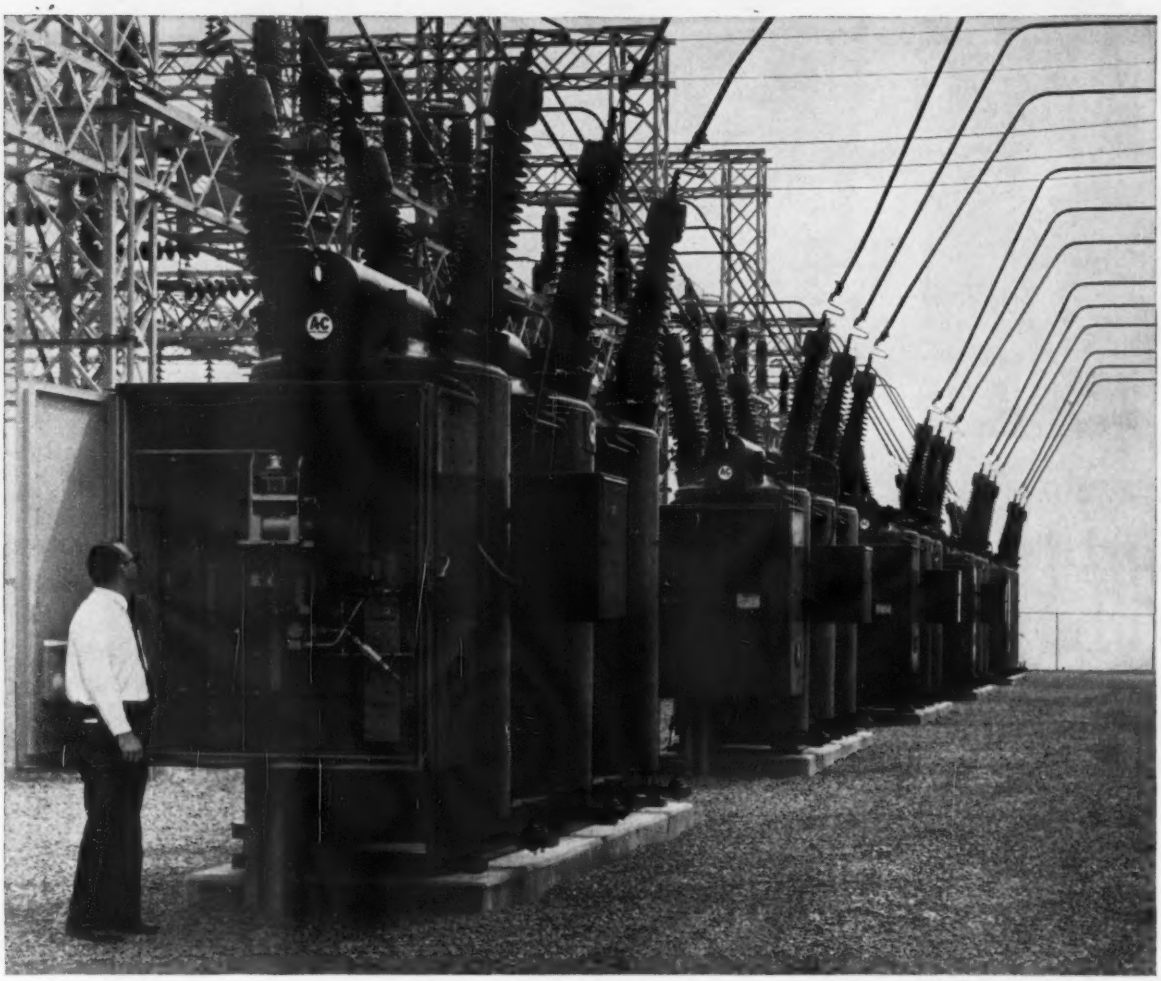
LINE MATERIAL® Industries Transformers
McGRAW-EDISON COMPANY

476

DISTRIBUTION TRANSFORMERS • RECLOSERS, SECTIONALIZERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS
LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT • PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS
OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE AND CONDUIT

McGRAW EDISON

ALLIS-CHALMERS



Line-up of A-C breakers with Pneu-Draulic operators at Niagara Mohawk's Porter Station.

Our breaker customers know what they want:

98% demand Pneu-Draulic operators

High-speed interruption, consistent reliability and low maintenance costs —these account for the decisive preference for A-C circuit breakers with *Pneu-Draulic* operators. In 6 years since their introduction, *Pneu-Draulic* operators have won acceptance of 160 companies. Over half our sales are repeat orders.

Preferred advantages include safe closing of breaker at full rated speed onto energized line, even when no control power is available, thanks to reliable stored-energy mechanism. Design is climateproof... oil instead of air eliminates need for anti-freeze solutions and rules out moisture and corrosion problems.

Get the facts on *Pneu-Draulic* operators — available on all Allis-Chalmers outdoor breakers rated 14.4 to 345 kv, 500 to 25,000 mva.

Call your nearby A-C office or write ***Allis-Chalmers,*** *Power Equipment Division, Milwaukee 1, Wisconsin.*

Compare these advantages —

- Compact size, with few moving parts.
- Protected against rust, freezing and corrosion.
- Automatic emergency closing at full rated speed even without control power.
- Complete system protection with mechanically trip-free operator.

Pneu-Draulic is an Allis-Chalmers trademark.

A-1305

Now Is the Time to Urge Political Responsibility

The conventions are behind us, the candidates selected, and the party lines drawn. By now, the voters should know the broad issues. Electioneering between now and November will sharpen the various points in contention, and, we hope, make easier each individual's decision as to how to mark his ballot.

A good start has been made by some companies in encouraging their employees to take an active interest in politics. We are heartily in favor. What's more, as the fever of election excitement rises steadily from here on out, we urge those not yet doing so to take advantage of the high interest to provide encouragement.

Yet we sound a warning: The party platforms have some heady language with regard to natural resources and power planning. Unless companies are meticulous to avoid influencing employees as to how to vote, it will be easy for the charge to be made that the real intent of encouragement is to use duress.

Some companies may feel that such pressure on employees is legitimate on the grounds that the "proper" votes will help protect jobs through protecting the right of the organization to exist. Under some circumstances, this may be right and proper. After all, labor unions certainly don't hesitate to take public stands on parties and candidates.

But utilities are something else again. In our view, such partisan activity would, in the long run, backfire against utilities.

It is more desirable, we think, to encourage each employee to assume his full political responsibility as a citizen and leave it to his informed judgment as to how he should mark his important ballot.

If You're Interested in Cutting Costs

We hope that every utility management man in the country will take another look at our meeting report entitled "Who's Holding Back Aerial Lifts?" which appeared on page 44 of last week's issue. To us, it gives some insight into how cost-cutting techniques are slowed in gaining acceptance for utility operations.

In that particular case it was aerial buckets used by overhead departments. These buckets do away with the old spikes and belt that have become the hallmark of a utility lineman. They offer promise of speeding jobs and eliminating considerable back-breaking work. But the men in authority—the overhead superintendents, the personnel men, the transportation men—have run into an impass in many utilities in finding a way to bring these time-savers into their operations.

We have no way of knowing whether these devices would prove economical in every single utility operation in the country. We do know that a number of utilities have adopted them with apparent success.

There is general recognition among employees that top management is intensely interested in any expense-cutting techniques. But if management is to have a chance to capitalize this interest, it must find ways to help supervisors down the line put promising new techniques into practice.

Sherman Knapp talks to power plank writers at left . . . Electrical World's Stuart Ramsey

GOP Listens But Adopts

Partnership policy to be carried on. Knapp raps Democratic plank, especially Passamaquoddy approval, in interview

The Republican convention has adopted a natural resources development program that carries forward the basic partnership theme of the Eisenhower Administration.

In a much more restrained plank than the Democrats hammered out two weeks earlier, the GOP delegates approved the principle of "teamwork between federal, state and private entities" as being essential to the "wise conservation and sound development of all our resources."

The 1960 Republican power plank obviously took its cue from the report of the "Republican Committee on Program and Progress," drawn up in 1959 under the direction of Charles H. Percy, GOP platform committee chairman.

That report praised the "teamwork" approach of the Eisenhower Administration as having been responsible for the fact that almost twice as much generating capacity was added in the Pacific Northwest during the first five years of the Administration as in the five preceding years under Democrats.

The 1960 platform says: "The past seven years of Republican leadership have seen the development of more power capacity, flood control, irrigation, fish and wildlife projects, recreational facilities, and associated multi-purpose benefits than during any previous administration in history. The proof is visible in the forests and waters of the land and in Republican initiation of and support for the upper watershed program and the Small Reclamation Projects Act."

As was predicted by Rep Melvin R. Laird of Wisconsin, chairman of the GOP subcommittee on agriculture and natural resources, the 1960 power plank was primarily general in its approach. There were no references to specific power projects.

The platform pledged the "development of the new water resource projects throughout the nation," but did not go into detail on this subject. Nor did it vow to push development of other than water power projects, as the Democratic platform did.

Repeating pledges made in the 1956 platform, and in the Percy Report, the 1960 platform promised to observe basic principles of reclamation, honor the "preference clause" in marketing of federal power, and preserve the integrity of the states in governing water rights.

It also cited "continued federal support for Republican-initiated research and demonstration projects which will supply fresh water from salt and brackish water."

Cites Need for Fuel Research

The GOP platform referred to the need for "increased coal research" as part of its section on minerals, metals and fuels. The platform lashed the Democratic-controlled Congress for its "repeated failure" to enact long-range minerals legislation and promised to undertake long-range planning and programming for minerals and fuels.

The Democratic platform had cited the need for a national fuels policy.

Unlike some of the other GOP planks, the natural resources one did not require thorough re-examination after the 14-point "agreement"

interviews Ed Vennard . . . talks to M. R. Laird, subcommittee chairman . . . and Knapp

Own Power Plank

was reached between Vice President Richard M. Nixon and Gov Nelson A. Rockefeller. The plank was drafted after two days of open hearings and two days of closed sessions.

During the open hearing period, the subcommittee heard testimony on the part of the Edison Electric Institute and the National Rural Electric Cooperative Assn. Neither of the presentations, while representing divergent points of view, caused more than a ripple of reaction by the 15-member subcommittee.

NRECA had first crack at the platform writers (EW, July 25, p 41). The NRECA position was explained by Harry H. Nuttle, a director and secretary-treasurer of the Choptank Electric Cooperative, Maryland; and Charles A. Robinson Jr, NRECA staff engineer.

Nuttle distributed copies of a 14-page talk, but read only a portion of it. The paper asked that the GOP continue REA in its present state; accelerate self-liquidating federal multi-purpose water resource development; recognize the need for legislation to establish rigid qualifications for federal regulatory commission members and staff; consider federal sponsorship of a nationwide high voltage electric transmission grid jointly owned by the federal government and investor-owned, local, public and REA-financed electric utilities; and allow REA systems to participate in nuclear power programs.

Defends REA 2% Interest Rate

Nuttle hammered hard at the idea that nothing should be done to disturb the traditional 2% interest rate the REA gets on its long-term loans. The cooperatives can pay off their loans at this rate, he said, but if it was raised to 4% "I believe the power companies would take us over."

Robinson echoed this theme. The 2% rate, he said, is a "very small price to pay to bring central station electricity to 15 million Americans." He added that he believed REA had prevented socialization of electric power in rural areas.

The EEI presentation was given by Sherman R. Knapp, its president. Knapp told the subcommittee that the customers of the investor-owned electric utilities are "entitled to a civil rights plank which would recognize their rights to the benefits of tax equality, money cost equality and power availability equality."

He urged the elimination of the "special privileges" — exemption from taxation, low interest rates, and the preference clause—that apply to governmental power groups.

Subcommittee member Floyd Lee of New Mexico asked Knapp after his presentation if there was any alternative to REA in sparsely-settled areas of the West. Knapp replied that EEI had no quarrel with REA in regions where it would not be economically feasible to service consumers with private utilities, but he objected to REA expansion into urban areas and tapping of industrial consumers.

In a talk with an *Electrical World* reporter, Knapp also had some harsh words for the Democratic party's strongly-worded power plank. "We're very much disturbed by some of the things in the Democratic platform," Knapp said. "We certainly hope that they will never get to the point where they are actually in the works."

Knapp said he was referring particularly to the Passamaquoddy Tidal Power Project in New England, which the Democrats promised to "push forward." Knapp said Passamaquoddy was the "most absurd example of resource development to come down the pike in a long time."

Enrico Fermi Rehearing Denied by Court

Power Reactor Development Corp and the Atomic Energy Commission last week planned appeals to the US Supreme Court, after receiving another lower court setback against PRDC's (Detroit Edison) Enrico Fermi 100,000-kw nuclear power plant at Lagoona Beach, Mich.

The full, nine-member US Court of Appeals—meeting "*en banc*"—refused last week to rehear a June ruling by three judges of the same court against an AEC construction license for Enrico Fermi (EW, June 20, p 82).

The earlier ruling, based on an appeal by several labor unions (IUE, UAW, United Paperworkers), blocked the construction license until the Commission could rule favorably on the plant's operating safety. The unions had argued successfully that an AEC construction license is tantamount to an operating license, and, therefore, operating safety should be determined before either license is issued.

Actual construction at Enrico Fermi has continued in spite of the court actions. PRDC received another stay of the Appeals Court's order last week which will permit construction to continue while the case is carried to the Supreme Court. And construction will be allowed to continue until the high court rules on the AEC and PRDC petitions—very possibly not until 1961.

The Justice Department, arguing for the AEC, told the appeals court that a rehearing of the lower court's June ruling was essential to prevent "drastic impact" and "serious implications" for the nation's nuclear power program. "All the nine power reactors, and the majority of research reactors as well, have been constructed under provisional (construction) permits," said the Justice Department brief, raising the question that all these projects might be blocked by the Appeals Court's new interpretation of the AEC licensing procedures.

PUC Investigating Florida P&L Rates

Florida Power & Light Co has received notice from the Railroad & Public Utilities Commission that its rates will be investigated, beginning with a hearing Sept. 13.

Rumors that the R&PUC investigation would spread to utilities throughout the state were started when the R&PUC served a similar notice on the telephone company the following day (July 20), but were scotched by members of the R&PUC and electric utility spokesmen.

The Commission expects to find the FP&L rate of return at about 8.09%, according to General Counsel Louis Petteway. The fair rate of return was set at 6.98% by the Commission in 1957.

Malcolm McDonald, FP&L vice president, said the company believed its earnings were in line, and also expressed doubt that the R&PUC move was the beginning of a statewide investigation.

One story had it that the investigation started when FP&L agreed to pay Dade Co a $510,000 1959 franchise tax in May of 1960. R&PUC Executive Secretary Bolling C. Stanley said he remembered receiving a complaint about this, but added that the R&PUC observation of utility earnings is continuous and would not depend only on such leads.

Both Petteway and officials of Florida Power Corp and Tampa Electric Co said there was no change in the Commission policy and that other utilities were not affected.

After FP&L presents its case Sept. 13, opponents will testify, and the Commission will follow with cross-examination. Final action is a FP&L rebuttal and then the Commission decision.

SSC Rise Rating Kva	7200/12470Y-120/240 with taps		2400/4160Y-120/240 with taps	
	Old Price (Book Price)	New Price	Old Price	New Price
5	$ 138	$ 133	—	—
10	203	194	$ 188	$ 179
15	259	259	240	239
25	358	339	332	315
37½	468	468	434	433
50	569	545	532	510
75	753	753	711	711
100	939	928	886	876

GE Revamps Transformer Prices

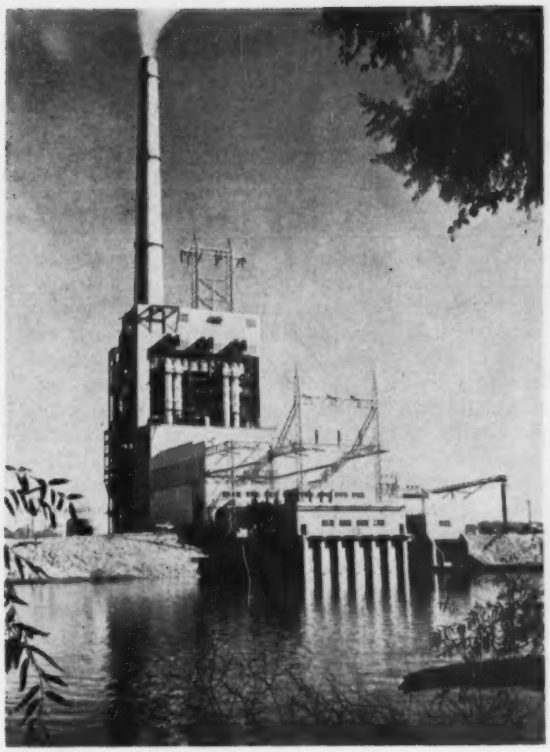
General Electric Co has announced book price reductions up to 5% on pole-type distribution transformers. The new prices, which are retroactive to 12:01 am, July 16, reflect electric utility industry desires for fewer standard kva ratings, and a recognition of market trends.

A survey of a cross section of utilities indicated that the "preferred series" of kva ratings would please 90% of the utilities surveyed. Another 5% would not commit themselves and 5% would be displeased.

Reductions of 1 to 5% apply to distribution transformers rated 10, 25, 50 and 100 kva at the 55C temperature rise. Comparison of net prices are shown in table above.

CORRECTION

Kansas City Gas & Electric Co (p 42, July 25) should have been called Kansas City Power & Light Co.



BREED PLANT: Aims at 8,535 Btu/kwhr efficiency

Uprated to 475 Mw, Breed Plant Starts Commercial Operation

The world's largest single-unit station, Indiana & Michigan Electric Co's supercritical Breed Plant, went into commercial operation this week. At the same time, an increase in its rated generating capacity, from 450 to 475 Mw, was announced by Philip Sporn, president of I&M and its parent, the American Electric Power Co. Sporn reported that the unit has been successfully operated at close to 500 Mw in tests.

The plant is located on the Wabash River, about 20 miles southwest of Terre Haute, Ind. A 186-mile, double circuit, 345-kv line connects Breed to the I&M and AEP systems at South Bend. Total cost of the plant, exclusive of switchyard, substations, and connecting lines is estimated at $71.5 million.

The unit is expected to have a thermal efficiency of 40%—8,535 Btu per kwhr. Steam pressure is 3,500 psi; initial and double reheat temperatures, 1,050 F. Although the unit can produce 110% more power than AEP's largest previous unit, 225 Mw, the space occupied is only 75% larger, reducing the capital cost per kw of capacity. The plant design includes provisions for a second 475-Mw unit.

The 1.4 million tons of coal Breed will use each year will be supplied by a 15-year contract with Ayrshire Collieries.

Navajos Approve 350-Mw Four Corners Steam Power Project

A major step forward in negotiations for construction of a multi-million dollar steam electric power plant on the Navajo Reservation near Shiprock, New Mexico, is reported by Paul Jones, chairman of the Navajo Tribal Council.

Jones said that the Tribal Council has approved, for forwarding to the United States Interior Department, proposals for development and operation of the project made to the Council by Utah Construction and Mining Co and Arizona Public Service Co.

If the agreements reached between the Council, Utah Construction and APS are approved by Interior, Jones said, APS will build a coal-burning, 350,000-kw electric generating plant on the reservation 10 miles southeast of Shiprock, N. M. Fuel for the plant will be mined and furnished by Utah Construction from 24,320 acres of undeveloped tribal lands. The lands containing large reserves of subbituminous coal have been leased to the company by the Council.

To be known as the Four Corners Power Plant, the APS facility will be built on a 1,250-acre site also leased from the tribe. It would be connected to the company's system by transmission lines extending across the reservation and into Arizona. An estimated capital investment exceeding $100 million would be involved in the initial development of the plant and transmission facilities.

Work on the two 175,000-kw generating units planned for the first-stage of the development would begin after approval of the proposals by the Interior Department, with about 30 months required for completion. Utah Construction's development of modern coal mining facilities would begin approximately at the same time.

Jones noted that the plan includes an agreement to wholesale power to the Navajo Tribe for use on the reservation. It also will supply a commercial market for the Navajo coal, will provide substantial royalties to the Navajo Tribe, more employment for its members, and substantial municipal and industrial development on the reservation.

The plant is also significant because it will be a power source feeding the proposed Colorado River Storage Project transmission grid.

Britain Reported Ordering First Supercritical Units

The Central Electricity Generating Board in Britain is reliably reported to have put out tenders for two supercritical pressure units.

The order is said to include two independent units for the site at Drakelo, each rated 375 Mw. The two 3,500-psi units will have 1,100 F initial and 1,050 reheat temperatures. The contract is expected to be announced in the near future. The units will be the first supercritical installations in Britain.

200-Kv Dc Channel Cables Selected

Twin 30-mile, dc submarine cable to link French, British systems. Four French, two British companies get contracts

The much-heralded English Channel cable got another big push toward reality last week with the announcement that cable contracts for the job had been let to two British and four French manufacturers.

Designed to link the French 225-kv network and the British 275-kv supergrid, the dc submarine tie will comprise two 30-mile cables, laid side by side, and three to four-mile underground cables at each end. Operating voltage will be 200 kv, with each cable insulated to 100 kv and the midpoint grounded. Cable rating will be 160 Mw, with 20% overloads for isolated periods of 30 min. This is reported to be the heaviest dc load ever carried under water.

Half the job, two 15-mile cable lengths, will be handled by Electricité de France, the other half by the British Central Electricity Generating Board. The two British companies, Associated Electrical Industries Ltd and British Insulated Callender's Cables, will build and lay the western half of the link. The $1.7-million contract will be divided equally between them.

The French contract went to a combine of four companies: Les Cables de Lyon; Les Trefileries et Laminoires du Havre; Societé Alsacienne des Constructions; and Forges et Ateliers de Construction Electrique et Mechanique.

Because of differences in time zones, climate, and living habits in the two countries, the cable will make extra generating capacity available to the two countries at a cost below that of constructing additional generation. Net annual saving to Britain alone is estimated to be $700,000. Total cost of the system is said to be $13 million.

The cable will come ashore near Dungeness in Britain and near Le Portel, a suburb of Boulogne, in France. Converter stations to rectify ac to dc and invert dc to ac will be established a few miles inland where the ties joins the French and British high voltage transmission networks.

The twin cables must be laid close enough to keep the magnetic compass deflection they cause down to two degrees at the sea surface. Maximum Channel depth is 20 fathoms on the British half of the job, 30 fathoms on the French half.

In 1958, sea-laying trials were made with a converted collier to determine the practicability of laying the go and return cables simultaneously at these depths and to check methods of inserting new lengths for cable repair. Principal problem is to prevent twisting and tangling of the two cables.

The British cable is single conductor, solid, oil-impregnated-paper design. Joints will be flexible. Although both butyl rubber and polyethylene have been under test in French labs, the insulated paper was considered mandatory for voltages above 100 kv. The submarine cable conductor has a 0.525 sq in. cross section and consists of stranded copper wire lapped with an electrostatic screen. A second screen is lapped over the solid paper insulation. Sheathing is lead alloy E, fitted with anti-twist tapes, and covered with vulcanized rubber tapes to reduce corrosion. Armoring is provided by a single layer of 0.232-in. galvanized steel wires. The British cable weighs 39 lb per yard in air and 28 lb per yd in water.

French Cable Differs

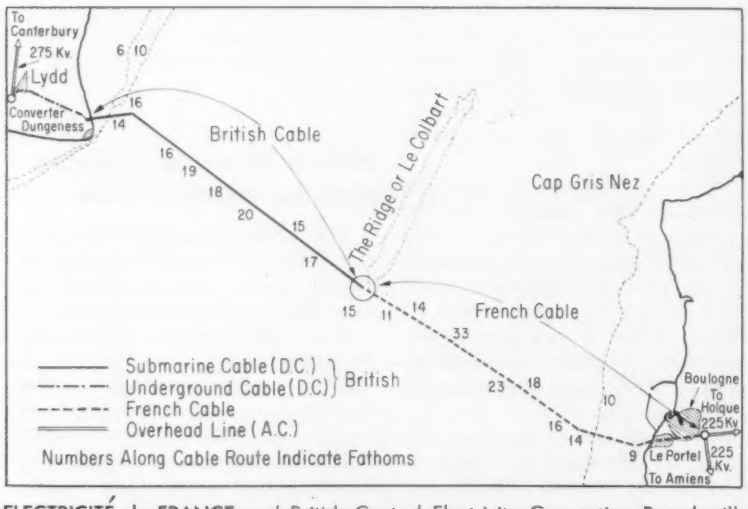
Because the soil around the underground runs at each end has poorer heat dissipating ability, conductors here will be 0.6-in. in loam areas and 0.925 in. in shingle areas. The land cable will have no anti-twist tape or submarine anti-corrosion protection and armoring will be smaller.

The French cable is slightly different. Next to the conductor lies a screen of carbon-black paper, and outside the insulation, a screen of metallized paper. Sheathing is pure lead, 0.085-in. thick. No anti-twist tapes are used.

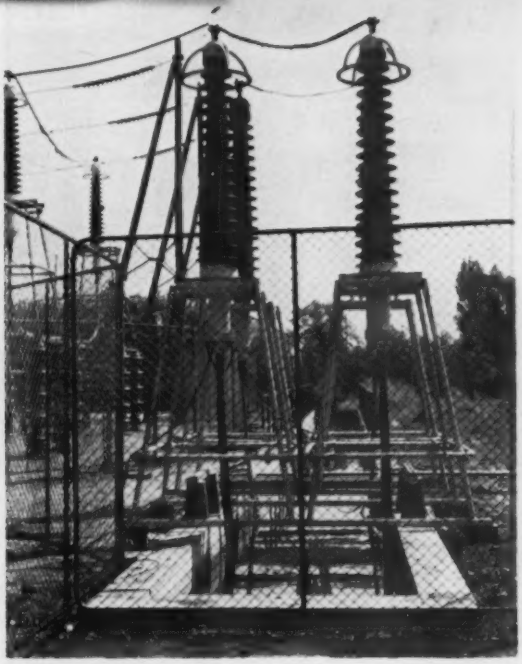
On the French cables, anti-corrosion protection is provided by a single layer of polyethylene 0.098-in. thick. Armoring is a single layer of 0.19-in. galvanized steel wires over a layer of jute 0.10-in. thick. The short length of underground cable from the beach to the terminal near Le Portel will have an 0.93-sq in. conductor.

The British half of the job will be laid by the converted collier used in the 1958 sea trials. The French will use a specially equipped vessel, the Ampere, owned by the government Post Office Dept.

Cable laying is scheduled to begin in the summer of 1961 and to be completed in the fall.



ELECTRICITÉ de FRANCE and British Central Electricity Generating Board will split 30-mile undersea cable. Maximum depth is 30 fathoms, on French side



PERFORMANCE TESTS for English Channel cable were conducted in trench filled with salt water at Fontenay lab

French Focus on Hv Cable

Paris, France—In France, today, three things are attracting engineering attention: **1.** The task of getting the vast amounts of natural gas from new-found sources in the Sahara Desert to centers where it can be used for power generation; **2.** The high voltage dc cross-channel submarine cable installation; and **3.** Expansion of high voltage cable in the Paris area.

Today Electricité de France (EDF) has a peak load of 11.5 million kw and an annual energy generation of something better than 64 billion kwhr. About half of this is produced by hydro, the rest by thermal generation. A good chunk of the steam generation has been produced by imported coal until recently. Today, thanks to vast new natural gas fields in the Lacq area near the Spanish frontier, EDF's coal importations are dropping as this natural gas flows through three major pipelines from Lacq to Bordeau, to Paris and east to the industrial area around Lyons in the Rhone Valley.

It's safe to expect EDF's concentration of steam generation to grow as soon as the brand new Sahara gas finds its way into the continent.

Three methods are being considered:

1. By pipeline from the Sahara fields to the Algerian coast and hence by submarine pipeline at a pressure of 450 atmospheres to the east coast of Spain and from there north to the Lacq region to tie in with existing pipelines.

2. An active alternative is to pipe the gas to the Algerian coast and burn it there in steam plants and transport the energy as dc in submarine cables under the Mediterranean again, probably to the Spanish east coast, and thence north to tie in with the EDF system.

3. Final alternative would be to liquify the gas and transport it by boat to appropriate ports.

At the moment informed opinion at EDF is that the first alternative will be the one adopted. However, it is significant to note that study of the dc cable alternative is still going forward, although at the moment it appears to be much more costly than pipelines. If it goes through, however, it will not be EDF's first dc venture.

The impending linking of the British and French power systems by a dc submarine cable under the English Channel has long been anticipated. As things stand today, the cable-laying will begin May, 1961. It will operate at ± 100 kv and have a capability of 160 Mw, over five times the power of the Gotland submarine cable link of the Swedish Electric Power Board which has been operating successfully now for a little over five years.

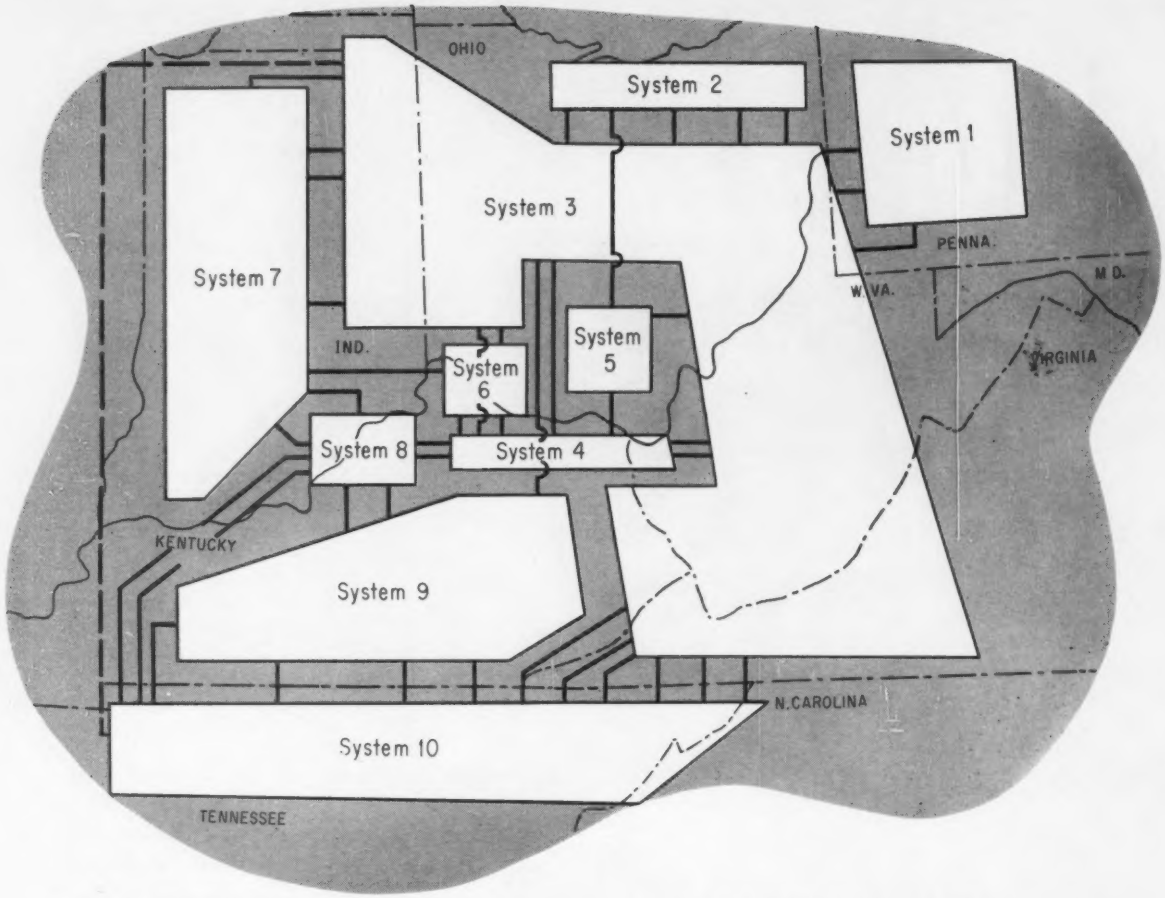
A good sign that EDF is looking with optimism to the possibilities of dc transmission is seen in the serious consideration being given to the erection of a high capacity dc research center outside Paris. At the moment EDF has a dc research facility at Fontenay of "only" 600 kv. A new test lab of perhaps 1,200 kv dc capacity suggests that EDF is gearing up to capitalize quickly on lessons they learned from the Channel cable. And it's not altogether impossible that such a new lab would play a key role in developing a dc link across the Mediterranean if such course should prove feasible.

Run 225 Kv to Center of Paris

Meanwhile, EDF's reliance on high voltage ac cable continues to be a strong factor in system development. On the last day of the recent CIGRE Conference in Paris (June 24) EDF laid the highest capacity 225-kv high pressure oil filled-pipe-type cable in the world, a 6.2-mile installation with a capacity of 300 Mva just a mile or two outside the Paris city limits.

Next year Electricité de France plans to carry 225-kv cable into the center of Paris where it will build a 225-kv underground substation feeding the Paris 12.5-kv distribution system. This is part of a plan to unify the Paris distribution system.

Electricité de France, like the German RWE utility system, is turning to 380-kv cable to link main power transformers at generating stations with nearby switch yards. In the case of EDF such an installation of 380-kv cable is currently being made at the Roseland Hydro Plant. The cable run is about 980 ft. The cable is an oil-filled type operating at a pressure of eight to ten atmospheres.



SPONSORING COMPANIES OF OVEC form an eight-state system studied for the first time using the new program. The network included 333 stations and 532 transmission lines. For the study it was divided into ten systems with 42 ties

Computer Program for Load Flow Study . . .

Handles Ten-System Interconnection

Greater speed and flexibility are designed into a program for the study of large complex networks on a computer

G. W. STAGG, Computer Application Engineer,

E. L. WIZEMANN, Computer Applications Section, American Electric Power Service Corp, New York, N. Y.

Successful simulation of interconnected system operation in the solution of load flows has been demonstrated by a new computer program developed by American Electric Power Service Corp. The program, written for the IBM 709, incorporates features designed to increase speed and flexibility in studying large complex networks. It is an expanded version of AEP's original 704 program (EW, Sept. 30, 1957, p 60) and reflects the knowledge gained by more than two years' experience in conducting load flow studies using a digital computer on a regular production basis.

The new program was used recently to study the operation of the interconnected systems which sponsor the Ohio Valley Electric Corp (OVEC), organized to supply power to the AEC plant at Portsmouth, Ohio (EW, Nov. 2, 1959, p 56). The study involved the facilities of utilities serving an eight-state area. The peak load represented was 16 million kw. The network included 333 generating and transmission stations and 532 transmission lines comprising some 10,000 miles of 132-kv circuits and 2,400 miles of 345-kv transmission.

This study evaluated the ability of the sponsoring companies to supply power to OVEC. The area was divided into ten systems and interconnected by 42 tie lines. A total of 66 cases was carried out using various interchanges of power between the

sponsoring utility companies and OVEC. Computing time was about 11 hr at a cost of $5,400. This amounted to about 10 min a case, including time required for the initial preparation and check-out of data on the machine.

By greatly simplifying the system (to a maximum of 300 lines and 200 buses) it would have been possible to study it on the largest available network analyzer. It is estimated, however, that even with this reduction in size the study would have taken about eight weeks at almost three times the cost of the study using the digital computer.

In addition to increased speed and flexibility, the digital approach provided:

1. An opportunity for the sponsoring companies to study in sufficient detail their individual system operations in relation to their commitments to OVEC.

2. Substantial reduction in engineering effort by completing this study within one week's time.

Development of this program is part of AEP's effort to expand the application of digital computers to the planning and operation of electric power systems. The program can be used directly on the new IBM 7090, which is much faster than and compatible with the 709. Availability of the new machine will result in a reduction exceeding 70% in computer costs for load-flow studies.

The new program was designed for systems as large as 550 lines and 350 buses. Generation and load may be specified for any of the system buses. Voltage levels can be maintained automatically within machine reactive limits for as many as 100 buses.

The tie-line control feature of the load-flow program permits the representation of 20 individual systems interconnected at as many as 50 points. Interconnection facilities may be represented by transmission lines, transformers and phase shifters. Scheduled interchange is controlled within a desired range by a regulating generator specified in each system. Adjustments for each regulating generator are obtained by first performing an iterative voltage calculation, using the original generation schedule.

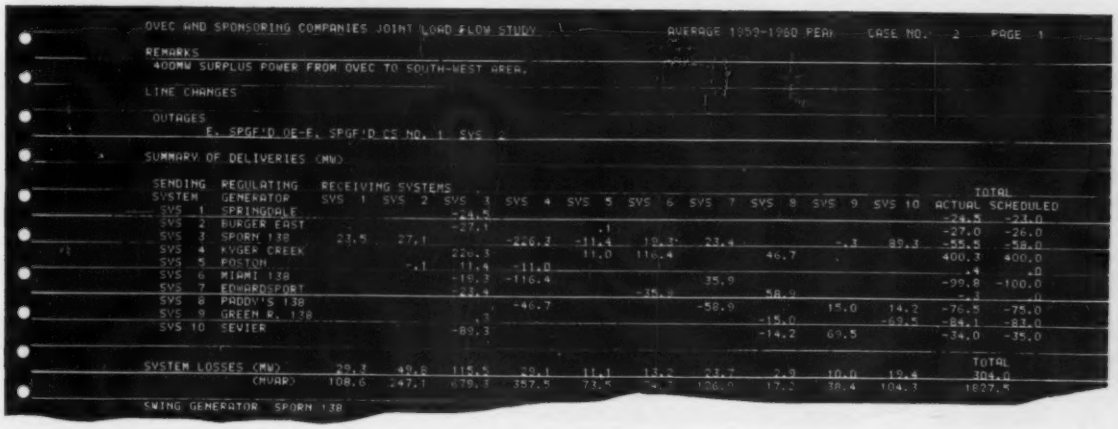
From this voltage distribution, individual tie-line flows are calculated and properly summed to obtain the total net interchange for each system. Then a comparison of actual and desired interchanges determines the adjustment to each regulating generator. This entire calculation is repeated until the difference between the actual and desired interchanges fall within a specified tolerance. Final line flows and losses then are calculated.

This method of adjusting the regulating generators for tie-line control produces rapid convergence. Based on a sample of 56 load flow cases it was found that an average of 2.3 additional voltage calculations were required for the desired interchange. However, each succeeding voltage calculation required considerably fewer iterations. The iterations for all additional voltage calculations amounted to 40% of all iterations for the case.

This 40% increase, however, represents an increase of only about 25% in the total computation time per case. The maximum number of additional voltage calculations re-

Increased speed and flexibility provide these new features:

- Automatic regulation of net interchange between interconnected systems
- Determination of individual company losses
- Automatic regulation of station voltages with TCUL transformers
- Control of power flow by phase-shifting transformers
- Output format identifies data with names of company, station and line



OVEC AND SPONSORING COMPANIES JOINT LOAD FLOW STUDY — AVERAGE 1959-1960 PEAK — CASE NO. 2 — PAGE 1

REMARKS
400MW SURPLUS POWER FROM OVEC TO SOUTH-WEST AREA.

LINE CHANGES

OUTAGES
E. SPGF'D OE-F, SPGF'D CE NO. 1 SYS 2

SUMMARY OF DELIVERIES (MW)

SENDING SYSTEM	REGULATING GENERATOR	RECEIVING SYSTEMS SYS 1	SYS 2	SYS 3	SYS 4	SYS 5	SYS 6	SYS 7	SYS 8	SYS 9	SYS 10	TOTAL ACTUAL	TOTAL SCHEDULED
SYS 1	SPRINGDALE			-24.5								-24.5	-23.0
SYS 2	BURGER EAST			-27.1		.1						-27.0	-26.0
SYS 3	SPORN 138	23.5	27.1		-226.2	-11.4	19.3	23.4		-.3	89.3	-55.5	-58.0
SYS 4	KYGER CREEK			226.3		11.0	116.4		46.7			400.3	400.0
SYS 5	POSTON		-.1	11.4	-11.0							.4	.0
SYS 6	MIAMI 138			-16.3	-116.4			35.9				-99.8	-100.0
SYS 7	EDWARDSPORT			-23.4			-15.3		58.9			-.3	.0
SYS 8	PADDY'S 138				-46.7			-58.9		15.0	14.2	-76.5	-75.0
SYS 9	GREEN R. 138			.3					-15.0		-69.5	-84.1	-83.0
SYS 10	SEVIER			-89.3					-14.2	69.5		-34.0	-35.0
SYSTEM LOSSES (MW)		29.3	49.8	115.5	29.1	11.1	13.2	23.7	2.9	10.0	19.4	TOTAL 304.0	
	(MVAR)	108.6	247.1	679.3	357.5	73.5	94.7	106.0	17.2	38.4	104.3	1827.5	

SWING GENERATOR SPORN 138

STATISTICAL RECORD of each computer run is provided by an auxiliary on-line output. Case number, system size and iterations for solution are printed out. During the calculation, speed of solution convergence may be monitored

quired was five and this occurred in only five of the 56 cases. New interchange tolerance for each system was ±5 Mw with the voltage calculation carried to within a tolerance of 0.0001 per unit voltage each time for acceptable load flow accuracy.

Because of the speed with which the regulating generators adjust to provide the desired interchange, the program has an automatic stop if more than ten adjustments are required, with an option whereby calculation can be continued. However, the maximum of ten adjustments is adequate even for a ±2 Mw net interchange tolerance. Should a stop occur, it is probably the result of an error in the data supplied to the computer.

For jointly-owned power stations, the program can allocate generation and load to meet contractual agreements. In each plant the net interchange between joint owners is automatically adjusted to actual billing delivery. On a network analyzer this usually is done by tying the two portions of the plant with a meter jumper.

The computer program can handle a maximum of 75 transformers, either fixed tap or tap-changing-under-load (TCUL). For TCUL transformers the program adjusts taps in predetermined steps to hold voltage within a specified band. Although the program is flexible, standard ⅝% steps to hold voltage within ±1% have been found most practical. Taps are adjusted continuously during the iterative voltage calculation and maximum and minimum tap positions are recognized automatically.

Experience with early programs, as well as with this new program, has shown that standard ⅝% step adjustments are sufficiently small to obviate in general additional iterations in the voltage calculations. The

OVEC AND SPONSORING COMPANIES JOINT LOAD FLOW STUDY

CASE NO. LINES BUSES TOTAL ITERATIONS ITERATIONS BETWEEN ADJUSTING REGULATING GENERATORS

33	532	333	79	56	23	
34	532	333	28	25	2	1
36	532	333	115	102	13	

37 INTERMEDIATE RESULTS

	ITERATION	MAX DELTA E-REAL	BUS	VOLT	ANGLE	MAX DELTA E-IMAG	BUS	VOLT	ANGLE
	78	.00072512	MIAMI 2-69	1.026	-20.0	.00274555	GREEN R. 138	1.020	-9.8
	79	.00077872	FRONT	.980	-22.4	.00257680	W. MT. VERNON	.983	-11.3
37	532	333	129	75	44	10			
38	532	333	20	12	5	3			

THE DATA FOR THIS CASE HAS BEEN SAVED AS RECORD NO. 4 ON TAPE NO. 777

TOTAL TIME OF RUN 9.90 - 10.58 9/23/59

CASE NO. 2 PAGE 6

AMERICAN ELECTRIC POWER

STATION CONDITIONS

	VOLT	ANG	GENERATION		LOAD			VOLT	ANG	GENERATION		LOAD	
TIDD 138	.985	2.3	170.0	46.4	146.0	82.0	TIDD 345	.970	4.9	.0	.0	.0	.0
KAMMER 345	.984	6.3	.0	.0	.0	.0	KAMMER 138	.990	7.7	680.0	97.7	383.0	185.0
GEO. WASH.	.968	6.3	.0	.0	7.0	13.0	NATRIUM	.988	6.5	.0	.0	47.0	10.0
SUMMERFIELD	1.017	6.7	.0	.0	18.0	5.0	MUSKINGM 138	1.050	7.8	390.0	-7.8	27.0	12.0
MUSKINGM 345	1.005	6.6	390.0	71.6	.0	.0	PHILO NORTH	1.030	1.2	182.0	17.4	51.0	25.0
PHILO SOUTH	1.030	1.7	118.0	41.8	18.0	3.0	N'COMERSTOWN	.968	-3.8	.0	.0	32.0	12.0
W. M. PHILA.	.965	-4.5	.0	.0	15.0	3.0	SUNNYSIDE	.967	-4.5	.0	5.0	105.0	15.0
WAGENHALS	.964	-4.7	.0	5.0	54.0	17.0	W. CANTON	.966	-5.3	.0	.0	17.0	1.0
TORREY	.969	-4.5	.0	5.8	101.0	34.0	WOOSTER	.950	-5.8	.0	.2	9.0	4.0
S. COSHOCTON	.960	-4.6	.0										

LINE FLOWS MW AND MVAR

TIDD 138 TO			TIDD 345 TO			KAMMER 345 TO			KAMMER 138 TO		
WINDSOR	35.1	-6.9	TIDD 138	116.7	68.0	TIDD 345	116.6	51.1	TIDD 138	57.8	-10.4
WEIRTON	56.5	16.5	KAMMER 345	-116.3	-68.0	KAMMER 138	-91.1	33.9	KAMMER 345	91.1	-31.4
TIDD 345	-116.7	-61.1				MUSKINGM 345	-25.0	-85.1	GEO. WASH.	100.7	-39.4
KAMMER 138	-56.5	11.4							NATRIUM	47.6	-6.1
GEO. WASH.	-39.7	20.9									
SUNNYSIDE	42.1	-8.2									
WAGENHALS	54.0	-2.9									
TORREY	49.2	-5.1									

GEO. WASH. TO			NATRIUM TO			SUMMERFIELD TO			MUSKINGM 138 TO		
TIDD 138	40.5	-21.4	PADEN FORK	8.6	5.2	NATRIUM	8.0	22.4	NATRIUM	16.4	22.9
KAMMER 138	-97.5	39.6	KAMMER 138	-47.4	6.1	MUSKINGM 138	-25.9	-27.4	SUMMERFIELD	26.3	25.9
NATRIUM	-15.0	-31.0	GEO. WASH.	15.1	30.4				MUSKINGM 345	61.3	-70.0
			SUMMERFIELD	-7.8	-24.7				PHILO NORTH	134.9	.1
			MUSKINGM 138	-15.9	-26.9				PHILO SOUTH	124.7	1.2

MUSKINGM 345 TO			PHILO NORTH TO			PHILO SOUTH TO			N'COMERSTOWN TO		
KAMMER 345	25.2	49.1	MUSKINGM 138	-131.6	12.3	MUSKINGM 138	-121.9	9.1	PHILO SOUTH	-73.1	-13.6
MUSKINGM 138	-61.3	72.9	PHILO SOUTH	-10.4	.0	PHILO NORTH	10.4	.0	W. M. PHILA.	15.4	-1.9
E. LIMA 345	172.9	-31.2	TORREY	37.6	9.1	N'COMERSTOWN	76.2	18.3	S. COSHOCTON	25.9	3.4
SPORN 345	253.7	-19.1	HOWARD	53.2	1.0	SUNNYSIDE	28.8	4.1			
			N. NEWARK	52.3	-5.2	TORREY	40.6	6.6			
			ZANESVILLE	53.1	-9.9	HOWARD	55.9	.9			
			CROOKSVILLE	51.8	-7.0						
			SPORN 138	5.5	-7.8						

W. M. PHILA. TO			SUNNYSIDE TO			WAGENHALS TO			W. CANTON TO		
N'COMERSTOWN	-15.3	.4	WINDSOR	-39.8	6.9	TIDD 138	-52.5	4.1	S. AKRON	44.3	-7.7
SUNNYSIDE	.3	-3.4	TIDD 138	-40.4	7.5	SUNNYSIDE	-22.9	-7.3	WAGENHALS	-21.1	7.8
			PHILO SOUTH	-37.0	-7.4	W. CANTON	21.1	-8.7	TORREY	-40.2	-1.1
			W. M. PHILA.	-.3	1.1						
			WAGENHALS	22.9	7.0						
			TORREY	-8.9	-25.0						

NEW OUTPUT FORMAT clearly identifies system buses using the names of the system, generating or transmission station, and transmission line. This format expedites analysis of the study by relating results to actual system facilities

continuous check on those buses automatically regulated by TCUL transformers, however, does require additional computing time during the iterative calculation. This has raised the question as to whether intermittent checking might be sufficient. For example, a check every fifth iteration would reduce the computing time for the voltage checking portion of the program by 80%. Additional tests are being made to determine the feasibility of this revision.

Provision also is made to control voltage and power by phase-shifting transformers, on which there may be 100% compensation or no compensation. An in-phase tap setting as well as angular shift in degrees may be specified for phase-shifting transformers.

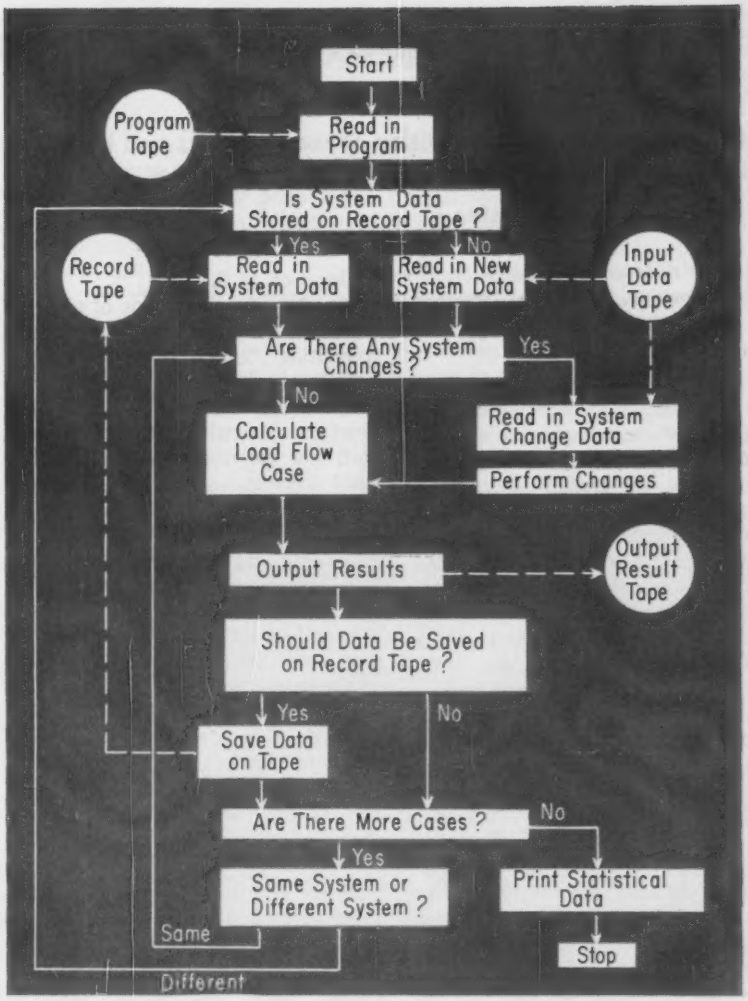
New Output Format Devised

A completely new output format for the program uses system, station and line names throughout, instead of code numbers, to identify system buses. This format expedites the review of results by effectively relating results of digital load flow studies to actual system facilities. The new output includes the name of the system, date, case number repeated on each page, load period and remarks. A tabulation of line changes, such as additions, outages, removals and conversions, also is included in the new output format.

Each line change is designated by its terminal bus names and a code name giving the system in which the change occurred. Following this information are final tap settings of all transformers, as well as capacitor and reactor flows. The listing of station conditions, two per line, includes the station name, per unit bus voltage, bus phase angle in degrees, and megawatt and megavar generation and load. Power and reactive line flows are tabulated under their station name and are identified by the names of stations at the far ends of the lines. Plus values represent flows from the station.

When two or more systems are represented, station conditions and line flows are listed separately under appropriate system names. Net deliveries and receipts between systems are summarized in a matrix tabulation together with a comparison of actual scheduled interchange. A coded name quickly identifies each system. In addition, transmission losses incurred in each system are tabulated with the list of net interchanges. Each page of the output is numbered consecutively.

An automatic statistical record of each computer run is provided by an auxiliary on-line output which gives case number, system size and number of iterations for solution. As an option, information can be obtained during the calculation concerning the speed of solution convergence for effective monitoring of the calculations. If the solution is not approaching convergence the calculation will stop automatically and the computer will print out this condition.



FUTURE USES OF OUTPUT RESULTS are considered in the program. It allows a return to specified conditions for new cases, or it permits the calculation of several load flows for entirely different systems in one run on the computer

The procedure for the automatic calculation of a series of load-flow cases maximizes use of high-speed magnetic tape for input, output and recording. The entire program on a library tape is read in simultaneously with system data which can be loaded from a record tape, cards or an input-data tape. Data for a particular case can be recorded on tape for later cases either in the same or future computer runs.

This method of data storage permits returning to a specified system configuration or load level for a new series of cases. It also allows calculation of several load flows for two or more entirely different systems in one run.

Buyers Spur Revision in Distribution

Seeking more realistic definition of requirements and testing, buyers want more short-circuit capability for today's stiffer distribution systems

MARTIN F. BEAVERS, Advance Product Engineering, Distribution Transformer Department, General Electric Co, Pittsfield, Mass.

The urgency for revising distribution transformer requirements seems implicit in users' growing demands for units of greater short-circuit capability, the inference being that present standards are no longer realistic. Requirements differ from those of power transformers, and different test specifications seem desirable.

Today's stiffer distribution systems expose low-reactance transformers, especially the pole type, to greater short-circuit hazards. Accordingly, demands on manufacturers are for distribution transformers to withstand more than the "25 times" base current specified in Section 12-08.100 of American Standard C57.12-1958. Prudence should nudge responsible groups into reviewing standards in the interests of both users and manufacturers.

Utility companies formerly accepted distribution transformers largely for the satisfactory service similar units had given. Certified short-circuit tests were required in only a few instances. As the American Standard Test Code C57.12.90 lays down no procedures for short-circuit tests on transformers, tests to demonstrate short-circuit capability are made in accordance with the particular testing group's interpretations.

Thus there is need for specified procedures, obviating misunderstandings between manufacturer and user and clarifying what is meant by a short-circuit strength of 25, 35, or 50 times base current. To make the meaning of transformer short-circuit capability understandable, these factors also need clarification:

Transformer connections
Method of applying the test
Starting temperature
Duration of the test
Number of applications of test
Point on current wave to use in computing "times normal" value
Method of detecting failure.

To bring the many factors in short-circuit testing into focus, let us follow the test steps. First, how shall connections be made? Shall one winding of a two-winding unit be short-circuited, and rated voltage applied to the other? Or, shall the transformer be excited at rated voltage before a short-circuiting switch is closed on the other winding? Perhaps the former will be established as the most convenient procedure in the testing laboratory. In any event, correct timing is essential to assure maximum initial offset current as now prescribed in 12-08.400 of C57.12.00-1958.

'Calibration' Test Needed

When one winding has taps for ratio adjustment, some connections may produce an ampere-turn unbalance unfavorable to the transformer under short-circuit conditions. Presumably, the connection producing the greatest unbalance should be used.

A "calibration" test at, say, 10 times normal will be in order before the full short-circuit test in order to establish proper functioning of the equipment and proper timing.

Next, enough voltage should be applied to produce the desired current. This step, although seemingly simple, imposes on the test supervisor or inspector the obligation of deciding whether the test requirements are met.

For example, examination of current and voltage waves as illustrated in Figs 1 and 2 reveals an offset current wave at the initial current peak, shifting towards a symmetrical wave with time and at a rate depending on the decrement factor of the transformer winding (an R/X function). The offset disappears after about 3 cycles, and the current wave from that point to the end of the record is symmetrical. Yet, because of heating within the windings, the symmetrical rms current between the third cycle and the end of the test decreases somewhat. This decrease, a function of the resistance and temperature of the winding, usually is larger on smaller transformers.

Test Current Defined

What point, then, should be used on the current wave for computing times normal? The first peak represents the highest current value and, accordingly, gives the highest electromagnetic forces on the transformer structure. Forces in the transformer, represented by the current wave in Fig 2, are $(1.5)^2$ or 2.25 times the forces after the transient subsides to symmetrical current in about 3 cycles. These forces decrease progressively as the symmetrical current decreases, being proportional to the square of the current.

When "times normal" strength is computed on the basis of the first offset current peak or of the first peak of symmetrical current, substantially higher values are obtained. But it cannot be claimed that this value was maintained for the full test duration, usually 2 sec for units with 4% or less impedance computed at 75C. Conversely, when current is read at the test's end, a lower value is obtained. This value is more conservative, and it may be said that the transformer withstood a minimum of so many times normal for the specified time.

Computing strength from the rms value of the first symmetrical current wave is very reasonable. It gives the maximum electromagnetic forces in the transformer due to rms symmetrical current. This value near the test's start is more readily predictable from normal impedance calculations based on initial temperature, as temperature changes vary little during the first few cycles. Starting temperature, along with test duration and the number of test applications, affect test results.

Regarding test duration, there has been much discussion of a sliding

Transformer Testing Standards

scale as a function of the times base current, as given in 12-08.112 of the Standard. Large transformers are usually protected against system faults by fast-operating relays which trip the circuit in a few cycles. Even when reclosers are used, the total "on" period seldom exceeds 1 sec. But pole-type transformers frequently are protected by primary fuses, whose blowing time is a function of current flow.

Minimum duration, according to 12-08.112, is 2 sec. Thus the question arises whether short-circuit tests at 35 times, 40 times, etc., should be held also for 2 sec. As fuses and like devices open the circuit faster when a high current passes through them, the more realistic approach would seem to be to shorten the short-circuit duration in some proportion to the number of times normal current. Inasmuch as a sliding scale is already established in the Standard for short-circuit values of 25 times and less, extending this relationship to the higher times normal seems logical.

Provide for Higher Currents

Following this procedure for values greater than 25 times current and time combinations in the tabulation below produce approximately the same temperature under all these short-circuit conditions:

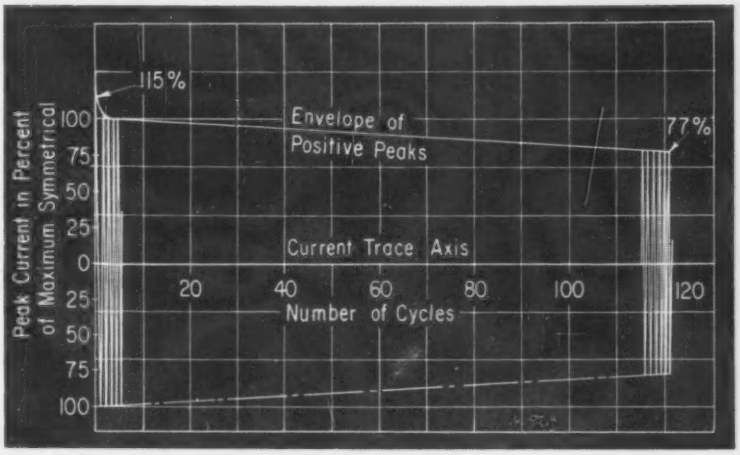
Times Normal	Time—Sec	I^2t
50	0.5*	1,250*
40	0.75*	1,200*
35	1*	1,220*
25	2†	1,250†
20	3†	1,200†
10.6	4†	1,100†
14.3	5†	1,000†

* Suggested values
† Present values

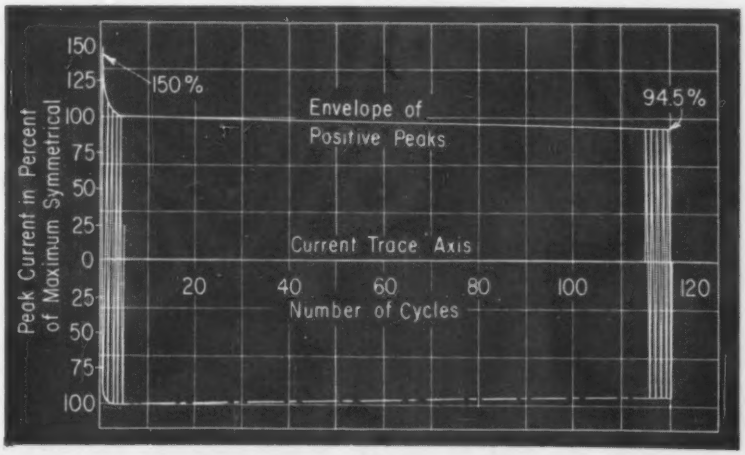
When a transformer is not capable of withstanding the specified test, coils or parts of a coil may shift or become distorted, causing a change in impedance. When this change is enough to cause an abrupt change in the current wave, failure detection may not be difficult. But a small change may be confused with normal changes due to heating effects. An impedance check before and after tests (corrected for temperature) may possibly serve as a basis for deciding whether the transformer satisfactorily withstood the short-circuit test.

If demand for short-circuit strengths in excess of 25 times continues to increase, industry agreement must be reached on what is expected of a distribution transformer under these more severe short-circuit conditions. General industry procedures should be established for ultimate incorporation in the American Standard Test Code.

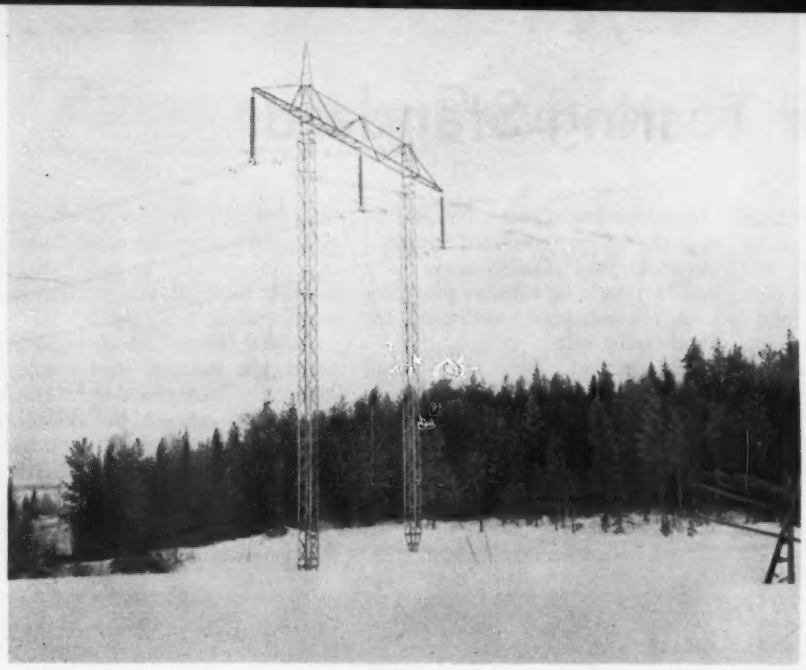
As distribution transformers generally are installed and employed differently than power transformers, the former should be considered separately with regard to industry short-circuit standards.



1 **SHORT-CIRCUIT CURRENT WAVE** of a small distribution transformer shows small initial offset and falling trend of symmetrical current due to heating



2 **SHORT-CIRCUIT CURRENT WAVE** of a large distribution transformer shows large initial offset and little drop of symmetrical current due to heating



ONE OF FIFTY of the new straight-line towers built with twin conductors as a test and now in use at 380-kv

Swedish State Power Board . . .

Develops Guyed Towers for 380 Kv

Design for 600-mile extension has three conductors per phase, yet is light enough to promise 31% steel saving. Guys designed to take up wind and broken wire forces

O. D. ZETTERHOLM, Chief Engineer,
L. O. BERG, Divisional Chief, Swedish State Power Board, Stockholm, Sweden

In Sweden a new type of 380-kv transmission tower has recently been developed that is lighter and less expensive than earlier types for similar use. It is an H-frame structure in which forces both perpendicular to and in the direction of the line are taken up by guys.

Sweden was the first country to build and operate a 380-kv transmission line, beginning in 1951 with the 600 mile, so-called Harsprang line. Since then, other 380-kv lines have been built; as of this year; the combined length is 2,000 miles. The reason for the extension of the 380-kv network—rapid for Swedish conditions—is the need to expand Sweden's electricity supply, which is based mainly on water power.

Unfortunately, the main sources of water power are in the north of Sweden while the bulk of the consumption takes place in the southern part of the country. As a result, a power transmission requirement has arisen which at present amounts to about 3,000 Mw, with an average transmission distance of about 400 miles. In 20 years the requirements for transmission of power are expected to rise to 8,000-10,000 Mw, over an average distance of 500 to 600 miles.

Previous Design Un-guyed

The 380-kv lines hitherto built in Sweden have all been supplied with 1,033,500 circ mil ACSR twin-bundled conductors. These line towers are of a steel H-frame type that has proved to be most suitable for Swedish conditions. Each tower leg rests on its own foundation and the forces perpendicular to and in the direction of the line are transferred to the foundation as a bending moment on the tower legs. By using series capacitors on the lines the transmission capacity has been brought up to between 600 and 700 Mw per line.

With continued expansion of Sweden's water power the demand for transmission capacity has increased and it has recently been decided to build about 600 miles of additional 380-kv lines, but with each phase consisting of three cables. As a result the mechanical load on the towers is increased so much that the tower legs and the foundations will have to be of a heavier type than usual. It is on account of this that the new transmission tower has been developed.

There are four guys, but the anchorages are so arranged that only two of them are required. These are placed in the center line of the tower

and sufficiently far from it to handle forces in the direction of the line and perpendicular to it. Thus the guys can take up both wind forces and broken-wire forces.

A tower with similar guying has been used in Finland and the Soviet Union. But those have the guys fastened in the tower legs at the cross arm, and sloping legs are used to control forces in the guys and to limit the flexibility of the tower. Because the legs are sloping the foundations also have to slope.

The new Swedish tower avoids sloping legs and foundations, to avoid difficulties in the construction work. Accordingly the guys are fastened to the cross arm as far outside the tower legs as the magnitude of guy forces and the flexibility of the tower will allow.

Three Conductors Per Phase

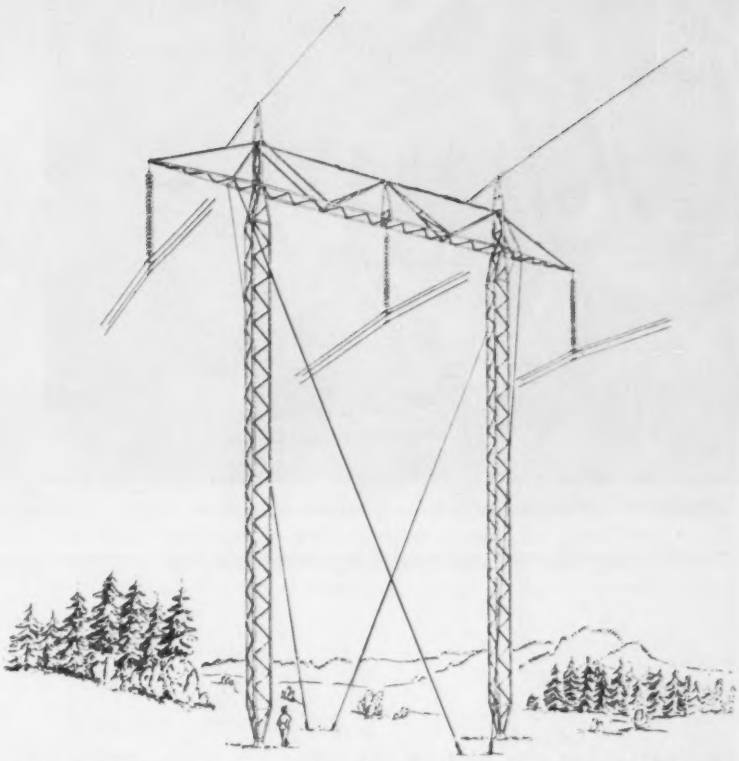
The new tower is designed for three conductors per phase. This is expected to result in a tower weight of 29 tons per mile of line compared to 43 tons per mile for earlier types designed for only two conductors per phase. The new towers are both lighter and cheaper; their cost is expected to be 31% lower in spite of the additional conductors.

The tower legs are quadratic. Frame bars are of steel angle 2¾ in. x $\frac{9}{32}$ in. with a breaking strength of 33 tons per sq in. Diagonals are $1\frac{9}{16}$ in. x $\frac{5}{32}$ in. angles, the smallest dimensions accommodating ½ in. bolts. As the stress is very small, the quality of the steel in the diagonals is not the same as in the frame bars. Weight of a standard tower leg of 72 ft will be about 1.1 tons. But both shorter and longer legs will also be required because of differences in terrain. Accordingly, tower legs are made up in lengths differing by somewhat more than 2 ft from 58 ft to 104 ft.

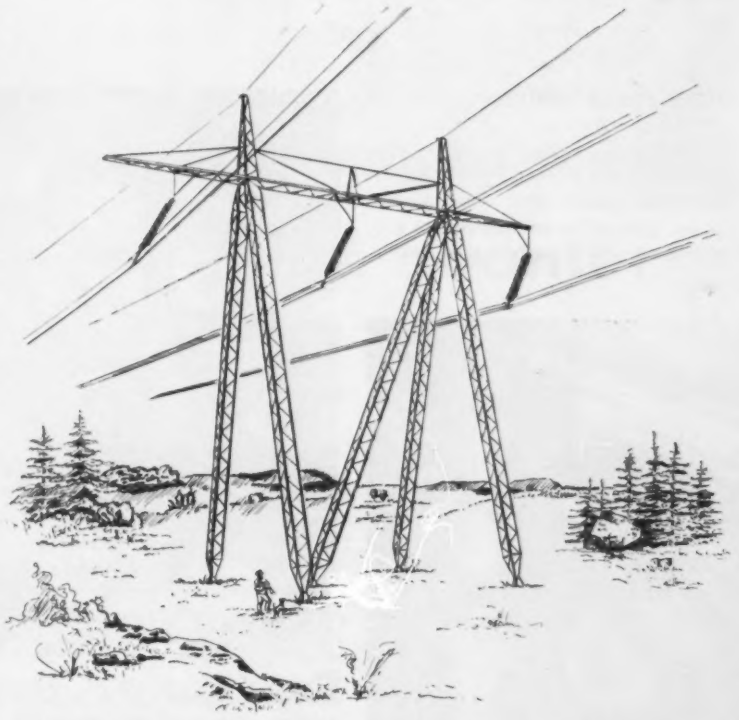
Tower legs have been designed to be suitable for standardized mass production. For example, all the diagonals in the legs are identical and their total number amounts to about 750,000 on the 600 miles of line now to be built. Frame-bars are of seven standard lengths. By combining these, 21 different leg lengths can be obtained.

For obvious reasons, tower cross arms cannot be constructed of such strictly standardized parts as the py-

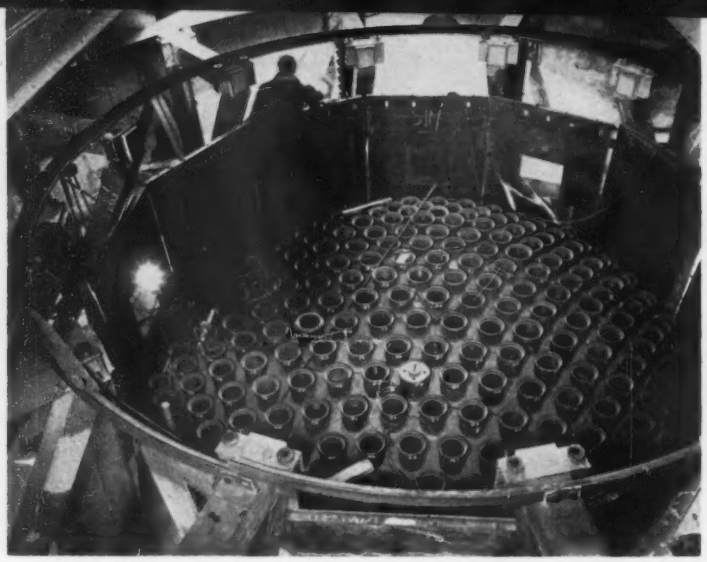
(*Continued on page* 76)



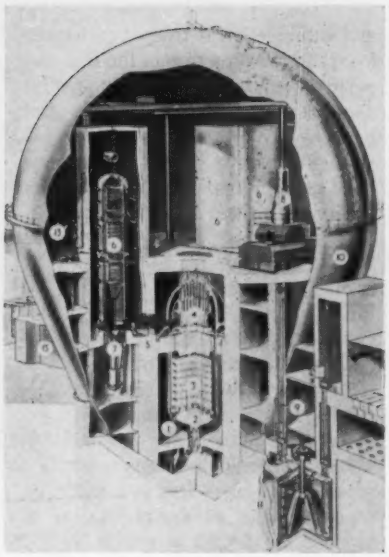
NEW TOWER for straight-line sections of 380-kv line has four stays. Anchorages are arranged on tower center line. Components are mass produced



ANGLE TOWERS have same type of legs and foundations, but these components are slanted. In this respect, they resemble towers used in Finland and Russia



FOREST OF REFUELING PORTS has been welded into the reactor vessel's head. A refueling machine, shown as item 8 in cutaway view to the right, can align itself over any port to within 0.005 in. The reactor will "burn" uranium enriched to 1.2% U_{235}. It is graphite-moderated

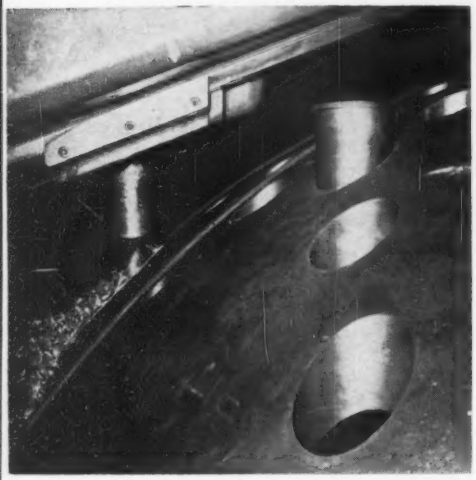


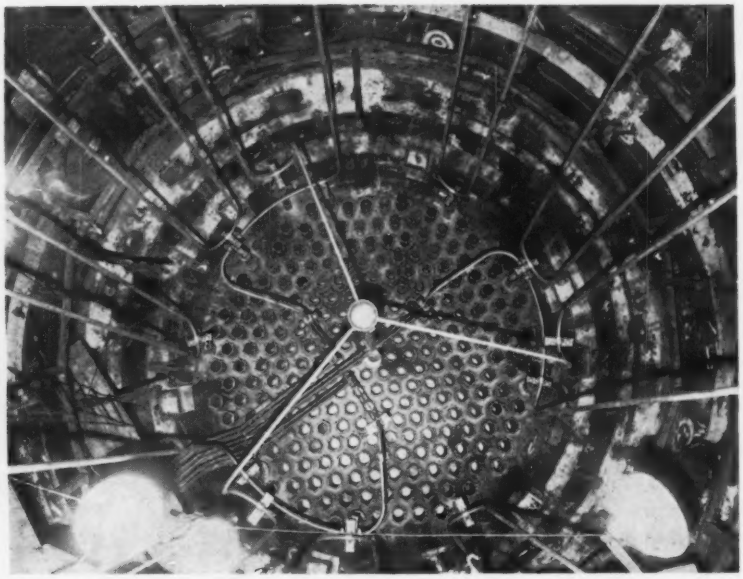
FOUR HEAT EXCHANGERS (6), one of which is shown in cutaway to the left, will generate superheated steam at 860F, about 650 psi. Reactor (4), in the center, will use CO_2 as coolant

At Windscale, British Build . . .

28-Mw Advanced Gas-Cooled Reactor

HOLE FOR A REFUELING PORT is drilled. Another port, set in its hole, is yet to be welded in place. The Windscale site is on the Irish Sea not far from Calder Hall, first nuclear power plant of large commercial size. Windscale will go critical next April





ARRAY OF TUBING IS A HEATER for stress relieving the reactor shell after welding. The vessel was assembled in place. This is the view looking up at the underside of the head. The 28-Mw Advanced Gas-cooled Reactor is the prototype for a 500-600-Mw unit planned for an industrial area

The facts behind the counter

To help you prove that G-E regulators cost less on the line

The operations counter on a General Electric step voltage regulator tells three vital facts-at-a-glance to the man who has to know—whether he be maintenance man, substation operator, or systems engineer.

FIRST—*If full advantage is being taken of the reduced bandwidths inherent in 32-step regulation—how much have regulator operations increased due to bandwidth reduction?* To provide *you* with an immediate answer for *your* system, *every* General Electric step voltage regulator is equipped with an operations counter. Through analysis of actual data, General Electric computer studies indicate that bandwidths as small as $\pm 3/4$ volts are desirable and feasible from *any* standpoint, including that of equipment life.

SECOND—*Is the regulator due for contact inspection?* General Electric voltage regulator design permits precise coordination of maintenance inspection with a definite number of tap-changer operations. The operations counter, therefore, eliminates any guesswork from the timing of major internal inspections. (You may find that G-E regulators on your system can be allowed to operate up to 25 years without switch-contact maintenance.)

THIRD—*How many regulator operations have occurred since the last inspection?* Any malfunction of the regulator controls, or system changes, will be reflected on the counter. This reliable "barometer" of regulator or system ills is another important reason why G-E regulators cost less on the line.

For more information on "the facts behind the counter," see your G-E apparatus salesman. Or, write General Electric Company, Section 456-04, Schenectady 5, N. Y. *Voltage Regulator Product Section, General Electric Co.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

Device Lifts OCB Cover Easily

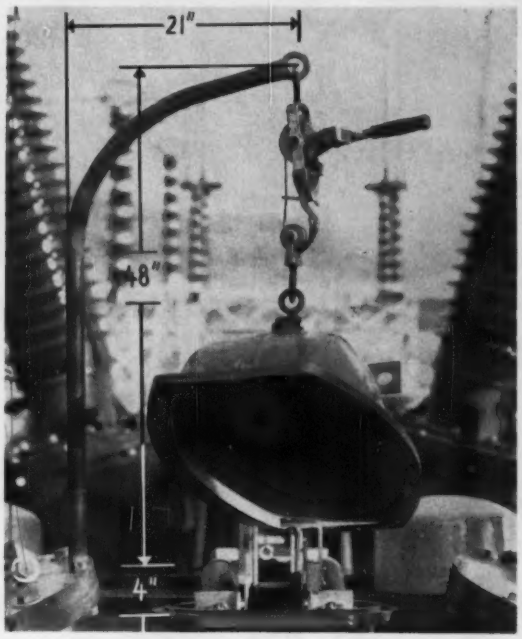
G. TOWNSEND, Maintenance Man,
A. BURK, Maintenance Foreman, Muskingum River Plant, Ohio Power Co, Beverly, Ohio

One man can handle the job of removing the cover on a 345-kv oil circuit breaker with a lifting device developed at Ohio Power Co. The simple device converts a former two-man operation into a safe and easy operation.

In the past the lifting of a 150-lb cover over the breaker-mechanism spring linkage took two men. This manual job was made more difficult by the presence of oil around the linkage box.

The new lifting device consists of a 54-in. section of extra-heavy 1¼-in. pipe formed to the dimensions illustrated. One end of the pipe was welded to the head of 1x4-in. machine bolt. The bolt was welded at an angle so that the device would be vertical when installed in a bolt-hole of a bushing adapter plate. This angle is the same as the bushing mounting angle. Welded to the other end of the pipe is ½x1½-in. eyebolt, which serves as a support for the winch hook. Fabrication of the device took only 2 man-hr.

Lifting power is provided by the small 1,500-lb ratchet winch hoist provided with the breaker. The cover is attached to the winch hook through a ½x 1½-in. eyebolt inserted into one of the 1-in. threaded vent holes, using a 1-to-½-in. reducing bushing. This eyebolt and other lifting gear are removed from the breaker before maintenance is complete. Caution should be observed during the lifting of the cover so that it does not swing sideways and strike the bushing.



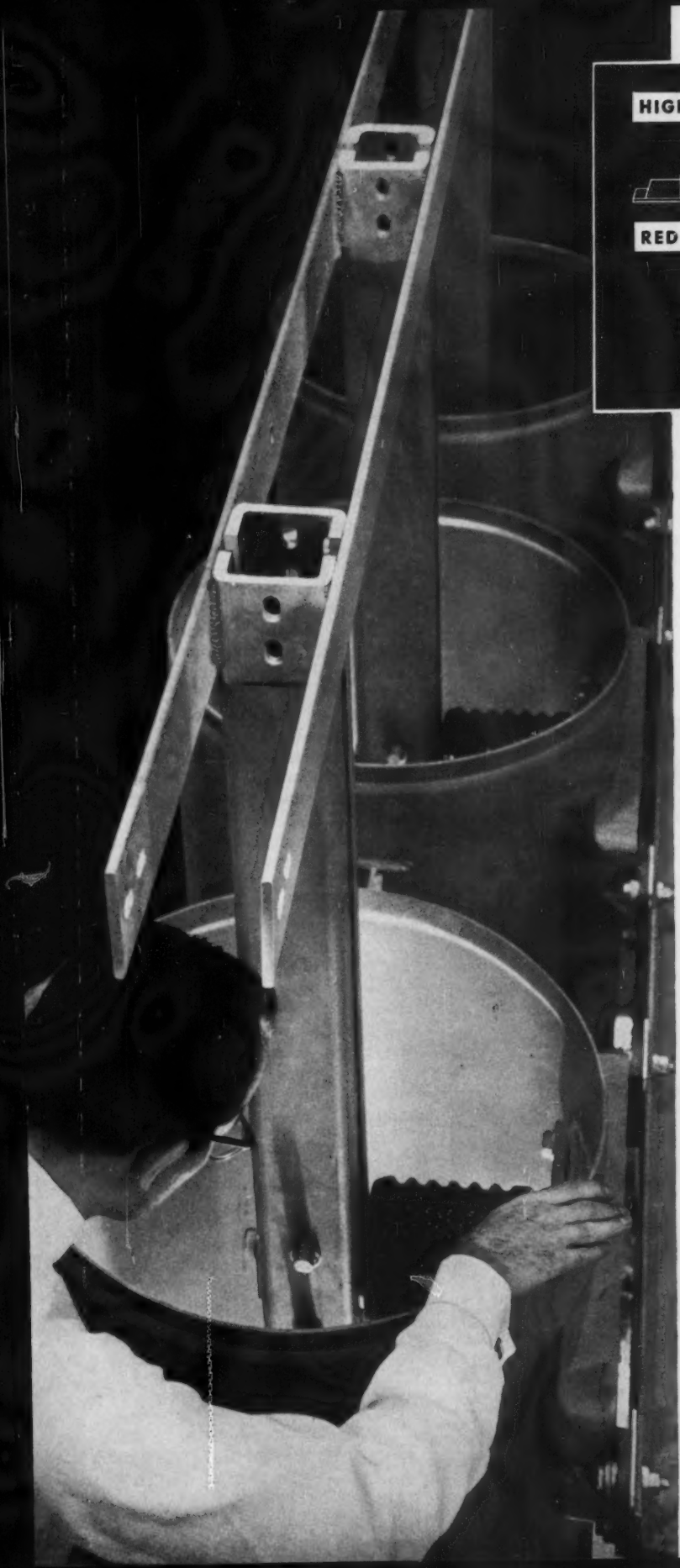
Check Lights Quickly With Bag on Pole

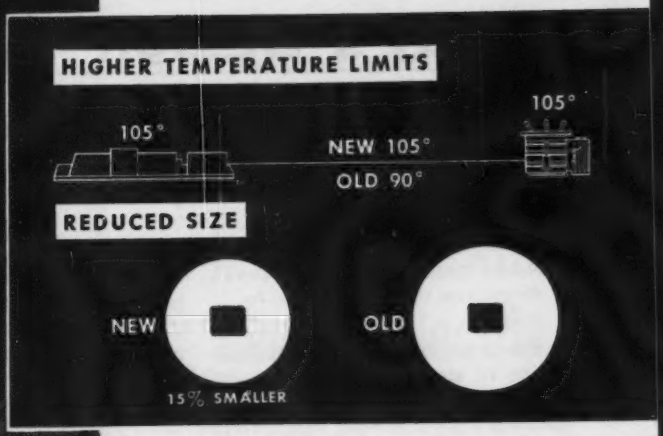
R. HUNTSINGER, Lineman,
L. KNEE, Lineman, Indiana & Michigan Electric Co, Marion, Indiana

A "bag on a pole" is saving time for maintenance crews of Indiana & Michigan Electric Co in locating faulty photoelectric street light controls in the daytime. The device saves about 3 hr per week in checking street lights.

Formerly it was necessary to use an aerial ladder or even climb the pole to block out the light from the photoelectric cell. With the new device the crew can move quickly from lamp to lamp.

The device consists of a heavy canvas bag which is attached to an 8-in. dia wire loop with a compression sleeve. This is mounted on a 20-ft section of lightweight glass fiber fishing rod, the smallest section of which has been removed. Cost of the bag was $1; cost of the rod, $15.





WITH GENERAL ELECTRIC ISOLATED PHASE BUS YOU GET . . .

Higher Temperature Limits— at Reduced Cost

New and tested metallurgical improvements combined with advanced welding techniques now permit the introduction of a 105°C isolated phase bus specifically designed to match turbine-generator and transformer hot-spot operating temperatures.

Upping permissible temperature limits by 15°C reduces bus diameter as much as 15 percent—with a corresponding decrease in cost.

Improved General Electric 105°C bus retains all the original advantages that have always made metal-enclosed duct a superior method of providing conductor support for bus runs. Single-insulator design, reduced maintenance, ability to withstand higher forces, and elimination of condensate problems are basic product benefits.

This new design improvement, a result of intensive fault and heat run testing, is still another contribution from General Electric to help electric utilities reduce their investment per kilowatt hour of operation. For more information, contact your nearest G-E Apparatus Sales Office, or write to Section 496-9, General Electric Company, Schenectady 5, N. Y., for Bulletin GEA-6874.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Load Boxes Help Evaluate Connectors

LEONARD GREER, Asst Chief Engineer, Penn-Union Electric Corp, Erie, Pa.

Power supply units, adapted from a line of standard test sets of the type used for circuit breakers and overload relays, provide high current to evaluate new connector designs. The power supply units or transformer type load boxes include continuously variable output controls used to readjust the current as it is affected by resistance changes in the test sample.

The only modification required is the installation of multi-range ammeters to monitor the current without the inconvenience and expense of using separate current transformers and ammeters. This modification is made by the power unit manufacturer.

In the connector laboratory, loop fabrication of heavy copper terminal straps and flexible shunts provide "sinks" to keep heat in test samples from entering the power unit. When necessary, these power supply units can be overloaded and used at well over the rated current by having fans blow air into the cabinet. Protection is provided by a circuit breaker combined with a thermal switch.

photo courtesy MULTI-AMP Electronic Corp

TEST ATTENDANT reads ammeter for high current sent through connector test loop by power ac supply unit. Penn-Union has five such units for testing

Time control for cyclic testing is provided by a wall-mounted timer with continuously adjustable "on" and "off" intervals. The timer is connected between the power unit and the 120-v supply receptacle. This arrangement proved more satisfactory than using a conventional cycle timer.

Samples Made of Conductor Loops

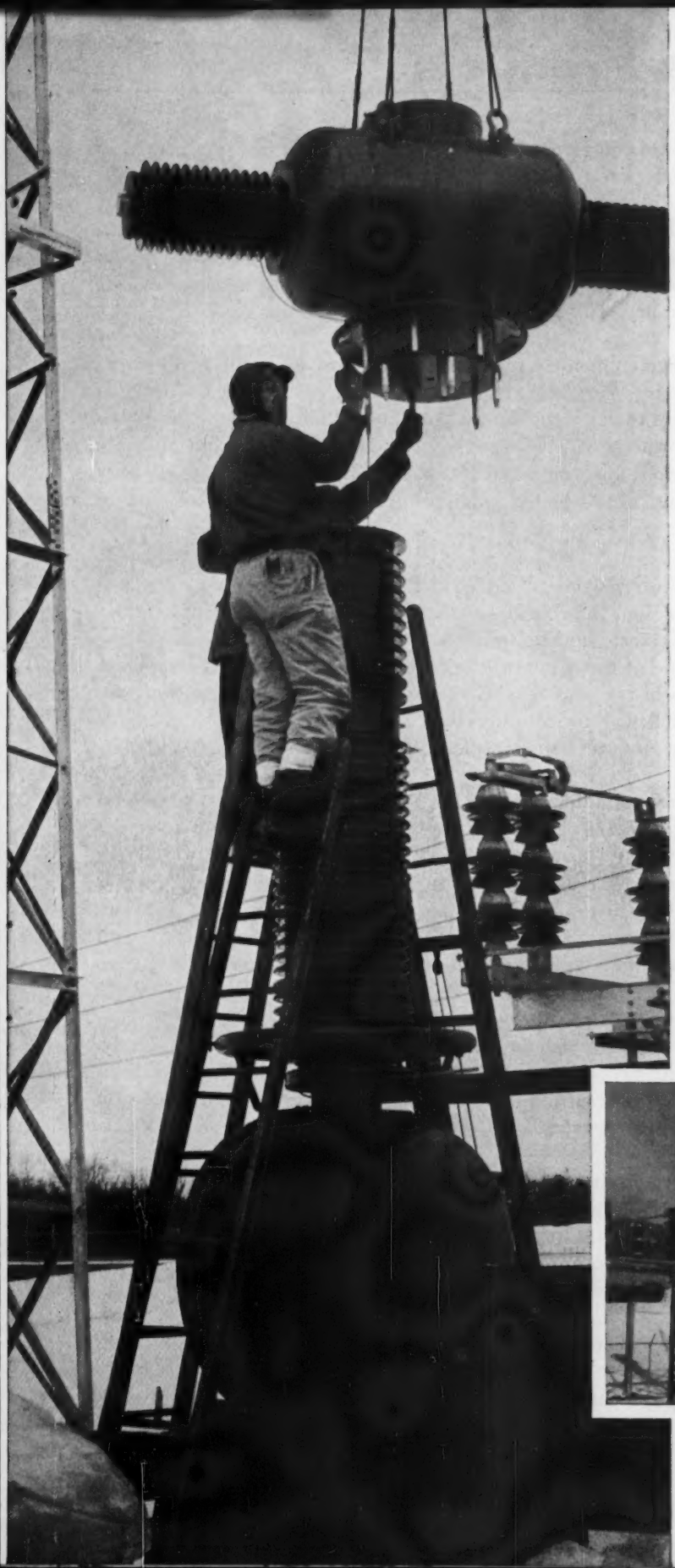
For the heat-cycling tests, samples are made up in loops of conductor joined by the connectors to be evaluated. Enough current is then sent through the loop to raise the temperature of the connecting wires to a value higher than that normally encountered in service. Popular test temperatures are 100C and 125C, depending on the duty class involved. Special application may require temperatures as high as 200C. These temperatures are on the conductor itself and are held constant during the test.

The temperature of the connector is compared with that of the conductor after the current has been on long enough for all parts to stabilize at their temperatures. A cycle is concluded when both wire and connector have been allowed to cool to room temperature.

Bimetallic joints and aluminum conductors and connectors are sensitive to thermal ratcheting, so this test cycle is repeated hundreds of times. Aluminum connectors and conductors sometimes appear to be of high quality at the beginning of a test.

However, as the number of cycles progresses, a poor design will gradually fail. On copper conductors and connectors, only a few cycles are necessary, and heat rise alone is usually sufficient.

These test cycles establish the quality of the connection and are the reason for carrying the number as far as is done by Penn-Union's research.



30% TO 50% LIGHTER WEIGHT, UNIT SHIPMENT MEAN YOU GET . . .

Fast, Easy Installation with General Electric Air-Blast Breakers

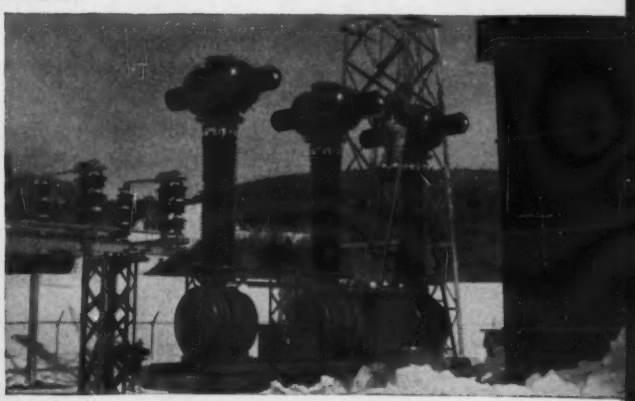
Installation of General Electric's air-blast circuit breakers is so simple it takes only a fraction of the time normally required to install comparable oil breakers. Here's why:

- **Units are 30 to 50% lighter** than comparably-rated oil breakers. They can be handled with one light-duty crane—no need to skid and jack them into place.
- **Current transformers and insulating columns are integral units.** Shipped in one piece, they are easy to unload and to lift onto foundation pads.
- **Interrupter heads are shipped complete,** ready to be lifted onto the support insulators and bolted into place after protective crating has been removed.

Why settle for less? For fast, easy installation, for practical protection for transmission systems 115 to 460 kilovolts and beyond, and for reduced maintenance, turn to General Electric air-blast circuit breakers. Contact your G-E Sales Engineer for more information. Or write to Section 494-05, General Electric Co., Schenectady 5, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC



ONLY SEVEN WORKING HOURS were required to install this three-phase G-E 115-kv air-blast breaker. Steps included unloading from railroad car, uncrating, transporting to installation site, lifting into place, and bolting down.

PRICES ▶ **Ohio Brass Co announces 5% price increase** on distribution insulators to become effective Aug. 15. Products affected are low voltage pin-type insulators, distribution post insulators, spools, insulated clevises, guy strain insulators, and suspension insulators of less than 10 in. dia. Paul M. Ross, manager of the power utilities dept, said that higher cost of labor, materials, shipping, and research and development made the increase necessary to assure a "modest profit margin."

PRODUCTS ▶ **One transformer manufacturer is holding firm on ratings,** following announcements of uprating by at least five others. RT&E Corp said it would adhere to a 55C rise and single transformer ratings for distribution transformers. RT&E President R. D. Nelson said the multiple kva ratings on transformers and 55C-65C temperature rises "are not only confusing but would be extremely difficult for the utility industry to apply."

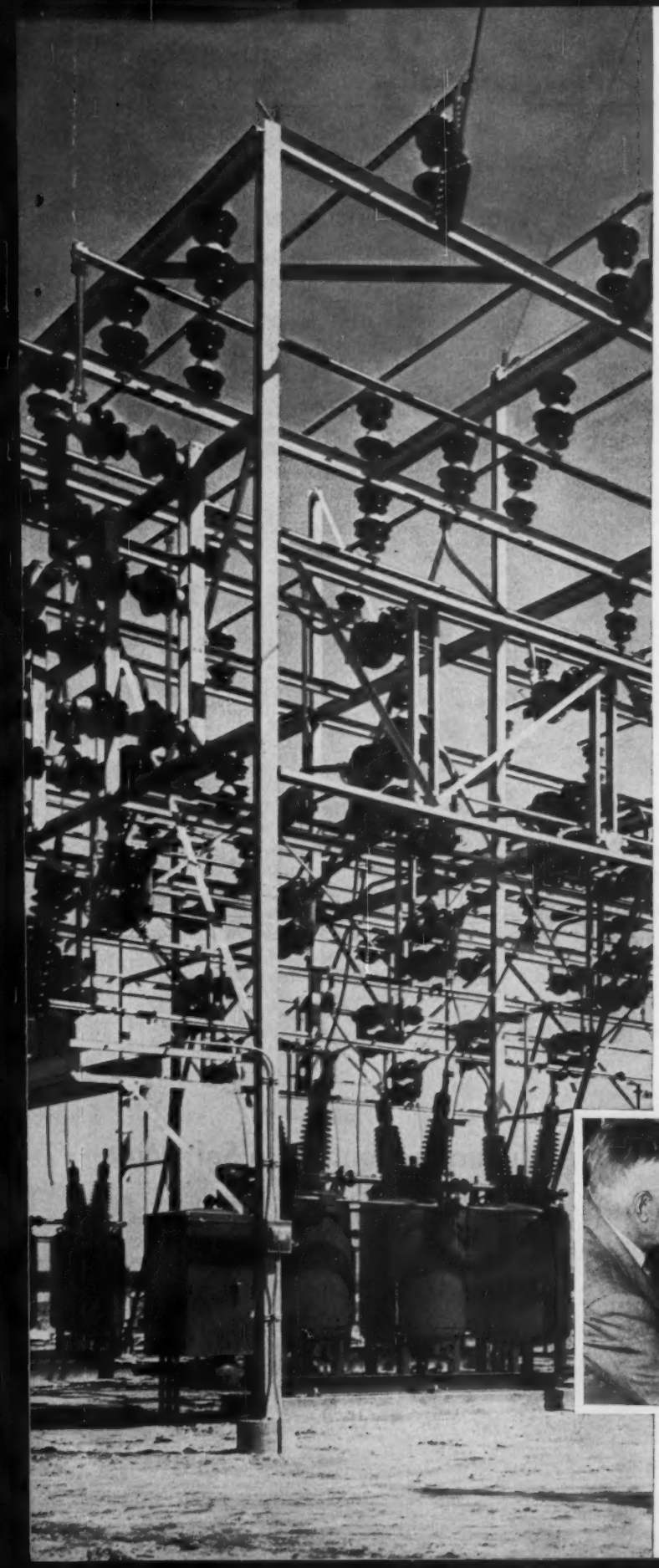
When 65C rise is standardized, RT&E will take advantage of new materials and design to produce smaller transformers with a single rating . . . at reduced costs, said Nelson. Until then, RT&E will continue rating its entire line of distribution transformers, pole type and Terra-Tran, on the basis of the present 55C rise. Customers, in the meantime, are assured that RT&E transformers have overload capabilities equal to or greater than any other transformer rated at 55C-65C, Nelson added.

FUEL **Pressure to ease oil import quotas for New England** states is building up in Washington. Sen. Leverett Saltonstall (R-Mass.) recently asked the Interior Dept for "prompt remedial action" to halt oil price hikes in New England. The Senator said the import quotas had caused a rise of 15¢ per bbl for residual oil in the area. As a long range solution, Saltonstall suggested that New England be given separate treatment with higher allocations than other Atlantic states which have alternative sources of fuel.

Utilities in the area will be hard hit, predicted Gardner A. Caverly, executive vice president of the New England Council. Boston Edison Co estimated the resulting increased cost of electrical power generation at about $1 million a year.

ALUMINUM ▶ **Aluminum stocks jumped up in April** and there are reports that there has been some build-up since. That helps explain why Kaiser Aluminum and Chemical Corp closed down another of its potlines at Mead, Wash., late last month. Only five of the company's eight potlines at that location are now operating. Domestic price remains at 26¢ a lb.

HANDLING ▶ **Rise in prices of material handling equipment is predicted** by major manufacturers. It will likely average around 3% to 5% on a broad range of equipment including that used in larger warehouses, say these sources.



WITH CUSTOM-TAILORED GENERAL ELECTRIC STATIONS, YOU GET . . .

Optimum Station Design, Plus Savings in Engineering Manhours

General Electric engineers have put digital computers to work to help custom-tailor outdoor stations. Result: You get optimum station design with minimum time required by your engineers.

Structural design is specified by General Electric engineers after detailed study of line requirements, and wind, ice and soil conditions. Use of digital computers assures that structural members have the required safety factor and lightest possible weight. Savings in material are passed on to you, of course.

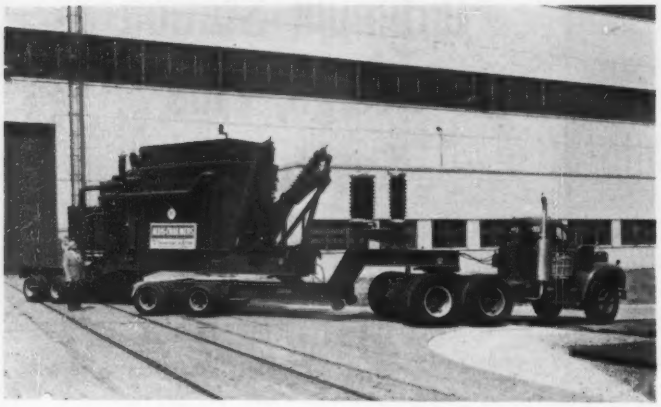
You may choose aluminum or galvanized steel structures when you select a General Electric-designed station. Furthermore, you have a choice of lattice-work type structures, or rolled-shape columns, as illustrated. Either way, you get the responsibility of one manufacturer, from design "up".

Why settle for less? For more information, contact your General Electric Sales Engineer. Or write to Section 495-11, General Electric Co., Schenectady 5, New York.

Progress Is Our Most Important Product

GENERAL ELECTRIC

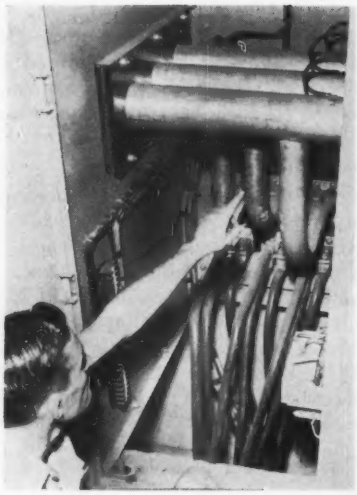
DIGITAL COMPUTERS ARE USED to help G-E engineers design a station to met your exact system requirements at minimum cost.



Mobile Transformer Shipped

A two-winding, 20-Mva, 3-phase mobile transformer (left) was recently shipped to California Electric Power Co by Allis-Chalmers Mfg Co. It is a 115,000-v grounded Y/66,400-v to 34,500-v delta unit with manual, no-load tap changers in the high and low-voltage windings and lightning arresters for high and low-voltage protection.

Such flexible mobile transformers will enable utilities to reduce outage time during emergencies and add needed kva capacity by releasing fixed spare transformers for use in new or existing substations, A-C says.

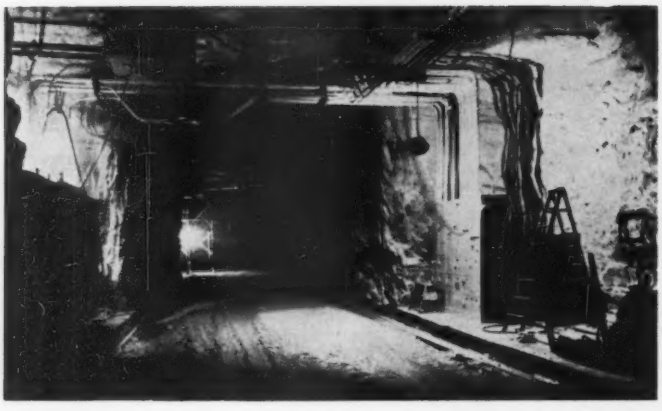


Welded Tubular Aluminum Bus Used

Aluminum Co of America has developed a new use for aluminum electrical bus conductor by installing 600-v electrical switchgear incorporating a conductor system of welded tubular aluminum bus. Engineer (left) is pointing to welded joint in bus, inside one cubicle. The bus conductor was built for Alcoa by Wolfe & Mann Mfg Co, Baltimore, Md., and installed by Alcoa as part of facility expansion at its Vernon works.

The welded tubular bus design was developed jointly by Alcoa and the engineering firm. Use of welded joints eliminates possibility of trouble from joint deterioration and permits lower operating temperatures, reports Alcoa.

Anticipated advantages of tubular aluminum bus for switchgear are more efficient use of conductors and increased mechanical strength for short-circuit bracing. Costs of welded tubular bus system appear comparable to conventional bolted rectangular arrangements, Alcoa says.



Aluminum Conduit in Salt Mine

Nearly 60,000 ft of rigid aluminum electrical conduit was supplied by Kaiser Aluminum & Chemical Sales, Inc, for this salt mine, the deepest in the US and first to be developed in 25 years. Mine, operated by Morton Salt Co, is 2,000 ft beneath the earth, located near Fairport Harbor, Ohio, on the shore of Lake Erie.

Conduit was installed bare, because of aluminum's corrosive resistance, even though salt environment provides a severe test for most uncoated metals, Kaiser reports.

(*More News of Manufacturers on page* 48)

WITH GENERAL ELECTRIC'S ONE-TANK DESIGN, YOU GET . . .

25% Reduction in Sub-transmission Breaker Maintenance

General Electric one-tank sub-transmission power breakers require up to 25% less maintenance time than conventional three-tank breakers. Here's why:

- **Five-cycle interruption** means shorter arc lengths, less carbonization and less contact wear. As a result, your inspection schedule can be spread out.
- **There's only one tank** to lower and raise, and this can be accomplished readily using a manual tank lifter. A pneumatic tank lifter attachment is available.
- **All six interrupters are easily accessible** when the tank is lowered. Loosening four bolts removes the interrupter to expose the contacts. No interrupter or bushing alignment is required. Linkage adjustments can be made externally at a crank box.

For more information on General Electric's maintenance-saving one-tank breakers for 15-kv through 46-kv service, call your G-E Sales Engineer. Or write to Section 494-02, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

ALL SIX INTERRUPTERS of G-E one-tank breaker are accessible when single tank is lowered. Contacts are exposed by loosening four bolts and removing interrupter.

When you select a size and grade of strand for a specific job you want to know that it meets every requirement of that job. You want ample strength to sustain the ultimate load—plus an adequate safety factor. You want pliability for ease of working in the field. You want ruggedness to withstand the abuse which may be encountered during and after installation. You want long, dependable life. And, you want reasonably low first cost and low maintenance costs.

For more than 50 years *Crapo* Galvanized Steel Strand has consistently demonstrated its ability to more than meet all of these requirements. Proof of its reliable performance is to be found in the case histories of overhead power and communication lines throughout the country.

Crapo Galvanized Steel Strand is fully protected against corrosion by heavy, uniform, dense coatings of commercially pure zinc tightly bonded to the individual wires. All grades and sizes are available in A, B and C weights of coating.

For details, ask our distributor or write direct!

INDIANA
STEEL & WIRE
COMPANY, INC.
Muncie, Indiana

GE Uses Silicone Varnish For Dry-Type Transformers

Changeover to inorganic silicone varnish impregnation for dry-type transformers, permitting higher temperature capabilities, has been announced by General Electric's specialty transformer department, effective August 1.

Previously applied only to the department's OHT line of transformers, use of the insulation varnish will be extended to include nearly all other dry-type general power transformer lines rated 5 kva to 1,000 kva.

The new type impregnation offers the potential of decreased size and weight in other transformer lines, says the company.

A completely automated process which thoroughly impregnates the transformer core and coils by alternate pressure vacuum cycling is used. System contains about 3,500 gal of silicone varnish at all times.

NEMA Announces New Memberships

Among new members of National Electrical Mfrs Assn are Saban Electric Corp, Winnisquam, N. H., Vulcan Radiator Co, Hartford, Conn., and Zenith Electric Co, Chicago, Ill.

Saban became affiliated with the Specialty Transformer Section, Generation, Transmission and Distribution Equipment Div. Company's President Walter H. Booth is voting representative. Vulcan joined the Electric House Heating Equipment Section, Consumer Products Div, represented by its president, John H. Ehn. Zenith became a member of the Industrial Control Section, Industrial Equipment Div, represented by Arthur Coren, sales manager.

Westinghouse, Sangamo, GE Report Earnings, Sales

Increases in first-half earnings and sales are reported by Westinghouse Electric Corp. Sales of Sangamo Electric Co rose and earnings decreased; General Electric Co sustained slight declines in both categories.

The Westinghouse 18% increase in net income after taxes brought first-half earnings to $40,454,000, compared with $34,150,000 a year ago. Record net income in the second quarter was $20,958,000, compared to last year's $19,741,000, the previous high. Net sales, $953,-844,000, increased 4% over the first half of 1959, and new orders billed went up 9%.

Sangamo's second-quarter sales rose to $13.9 million, compared to $12.8 million for last year. Earnings dropped to $463,000 from $689,000 last year. Sales for the first half totaled $25,616,000, compared with last year's $24,696,000; net income was $759,000, a drop from $1,465,000 last year.

Earnings for General Electric in the first half were $111,429,000, 5% lower than last year. Net sales billed were $2,022,699,000, 2% decline from first half, 1959. However, second-quarter sales billed showed marked increase over those of second quarter last year. Sales of industrial components and materials showed strong gains over 1959; decline was in defense products sales and in major appliances.

MANUFACTURERS BRIEFS

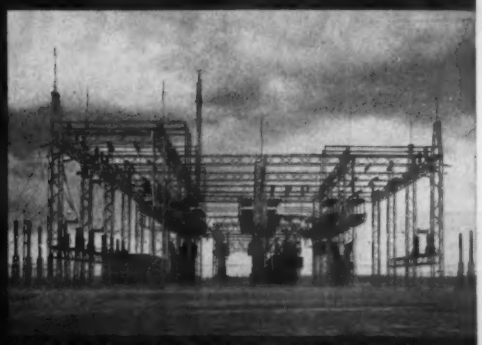
Two induction draft fans being supplied by **Westinghouse** for Union Electric Co's Meramec Station, St. Louis, measure 20x20 ft at base, are over 20 ft high. Each will handle up to 1,000 tons of air per hr at 210F.

Leeds & Northrup has been awarded a contract by Texas Electric Service for an automatic load control system which will be installed next year in the system's load dispatching office in Fort Worth. Included is the Desired Generation Computer, which will determine loading of system's ten units at six power plants (total capability, more than 1,000 Mw) and also be used in economic and fuel studies.

Reliance Instrument Mfg, Glen Cove, N.Y., has been purchased by **Electro-Mech,** Norwood, N.J., a wholly-owned subsidiary of American Chain & Cable. B. C. Webster, former reliance president, becomes the new E-M's division's general sales manager.

(*More Procurement & Products, p 52*)

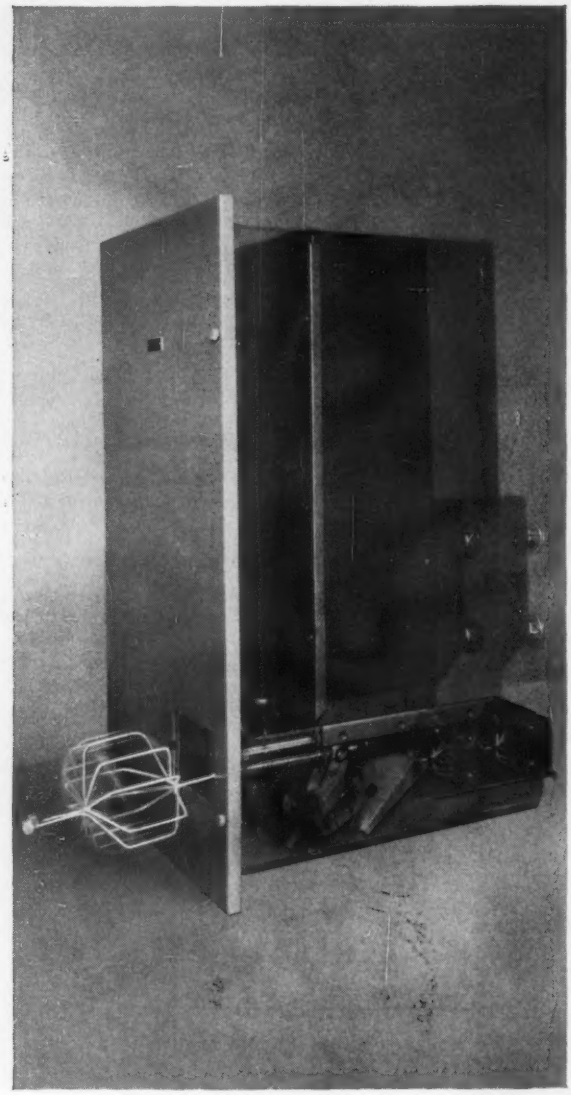
Single column of Type ATB air-blast power circuit breakers—115–460 kv.



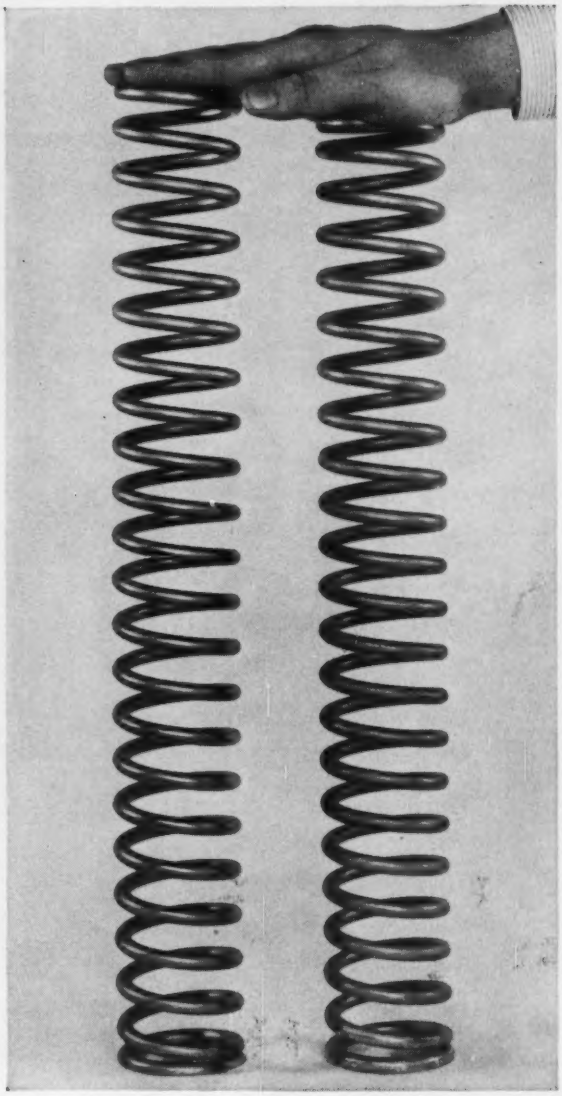
Completely designed and coordinated outdoor stations—7.5–230 kv.

What New Metal-

Has closed-door drawout...



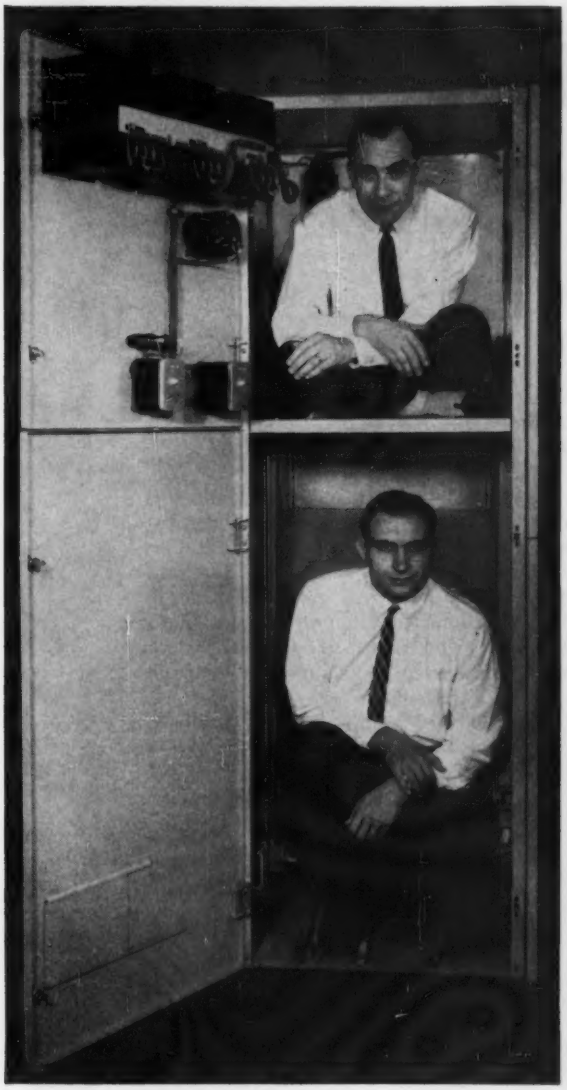
Stored energy as standard...



For complete answer, send for new illustrated Bulletin 2801-2A. And ask to see sound strip film that shows you every detail in only 18 minutes. Can be shown to you singly or to your group. Contact your nearby I-T-E sales office. Or write I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton St., Phila. 30, Pa.

Clad Switchgear...

More elbow room inside...

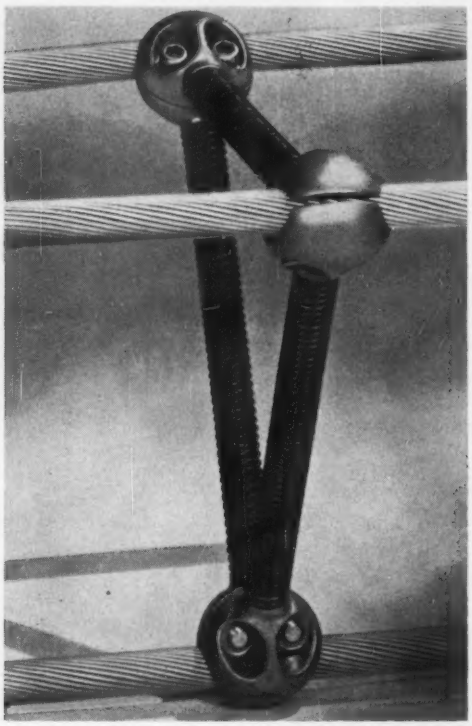


Yet fits in tighter spaces?

I-T-E CIRCUIT BREAKER COMPANY

Disconnect Switch . . .

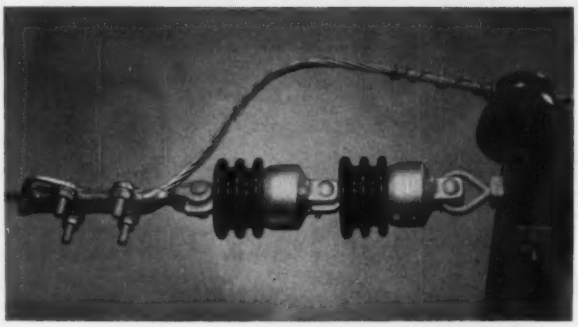
. . . is for horizontal mounting between a bus support and a circuit-breaker bushing in an outdoor substation. Rated at 115, 138 and 161 kv, the 600 and 1,200-amp switches have adjustable front contact mountings to compensate for variations in structure elevations. Each switch also features permanent lubrication, a counterbalance spring and a positive latch and pry-out assembly.
Line Material Industries, Milwaukee 1, Wis.



Spacer . . .

. . . for bundled transmission conductors comprises two aluminum oval clamps separated by a stainless steel helical spring. This design provides column strength to resist short-circuit forces and gives flexibility in other directions to permit normal conductor movement. The "tri-spacer" shown is a similar unit for three conductors bundled and has spherical clamps.
Rome Cable Div, Aluminum Co of America, 1501 Alcoa Bldg, Pittsburgh 19, Pa.

Deadend Insulator . . .



. . . with all-aluminum hardware is lighter than most distribution insulators. The forged aluminum cap and stud afford long service in corrosive atmospheres. Porcelain shell has high impact strength. Diameter of the insulator is 4¼ in.
A. B. Chance Co, Centralia, Mo.

(*More New Equipment on page* 54)

LOW OVERALL COST DEMAND MEASUREMENT

D **OES IT LOGICALLY**

The Duncan Thermal Demand Meter follows the same general heat-time curve that determines system capacity.

U **NNECESSARY PARTS ELIMINATED**

Long, reliable service is assured by a design using one moving part — moving only when the load changes.

N **O CALIBRATION PROBLEM**

Only one adjustment for up-scale point. Adjustments of the watthour meter do not affect the thermal accuracy.

C **APACITY TO MEET YOUR NEEDS**

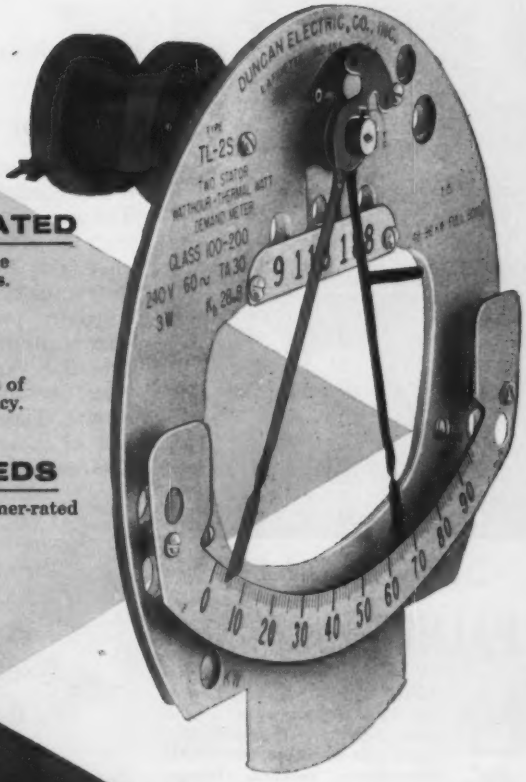
Available in a full line of self-contained and transformer-rated meters. Maximum range to 200 amperes.

A **CCURACY MATCHES LOAD**

The Thermal Demand Meter does not split peaks. It measures actual demand.

N **O LARGE INVENTORY**

Dual range scale combinations available to cover most rate structures with a minimum of meters.

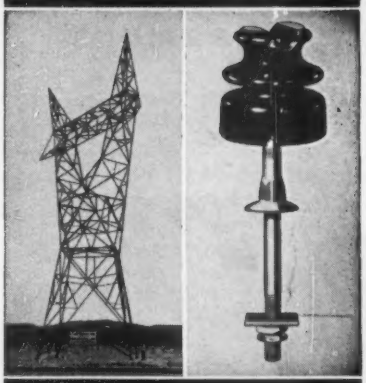


THERMAL METERS

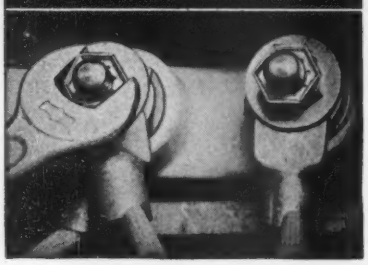
"Thinking Ahead ... Moving Ahead ... to stay Ahead of Demand"

WATTHOUR METERS • MOUNTING DEVICES • DEMAND METERS

Assemblies stay tight!



Connections stay tight!



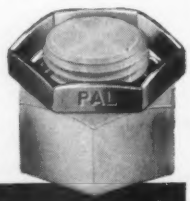
—when locked with

PALNUT LOCK NUTS

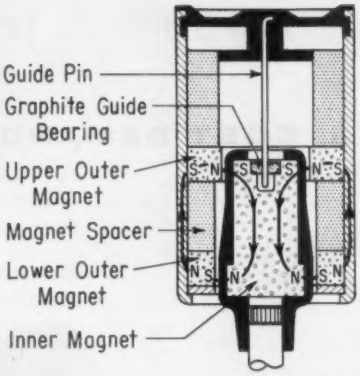
FOR years, PALNUTS have been the standard lock nuts of the utility industry—on steel towers, wood pole hardware, connectors, disconnects, switches, fittings, transformers, etc. Here's why: PALNUT Lock Nuts stay tight under severest vibration, are very low in cost, apply fast and easily, require little space. Available in full range of sizes, in plain, Parkerized and Hot Dip Galvanized steel; also silicon bronze.

Samples and literature on request.

THE PALNUT COMPANY
Division of
UNITED-CARR FASTENER CORP.
51 Glen Road
Mountainside, N. J.

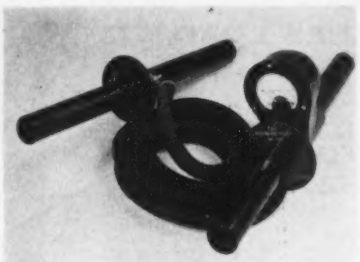


PALNUT
TRADE MARK
LOCK NUTS
for quick, secure fastening at low cost



Watthour Meter . . .

. . . **has a new magnetic bearing** of epoxy-bonded Alnico VII magnets. The graphite guide bearing found at each end of the rotor is centered in a guide pin. Type MQ meters have their insulation and arc gaps coordinated for protection against high-voltage disturbances. Voltage compensation makes the 3-wire, 240-v meter suitable for 2-wire, 120-v service. Type MQ meters are available in classes 10, 100 and 200.
Duncan Electric Co, Lafayette, Ind.

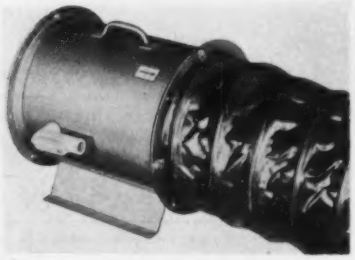


Phasing Voltmeter . . .

. . . **for overhead and underground** is sturdily built for field use. At rated voltage, 5 kv, current is 1.1 milliamp. The No. 2844 phasing voltmeter weighs 4 lb; its body length is 15½ in. Insulating parts provide safety and strength.
Western Electro-Mechanical Co, Inc, 300 Broadway, Oakland 7, Calif.

Potheads . . .

. . . **for pipe-type cable,** 69 to 345 kv, have been improved. Fully retained gaskets provide better pressure seals. Type AT potheads will stand up under 200 psig static head due to ground slope. The simplified design calls for a straight-through type ferrule connector to ease assembly.
G&W Specialty Co, 3500 W 127th Blue Island, Ill.



Portable Ventilator . . .

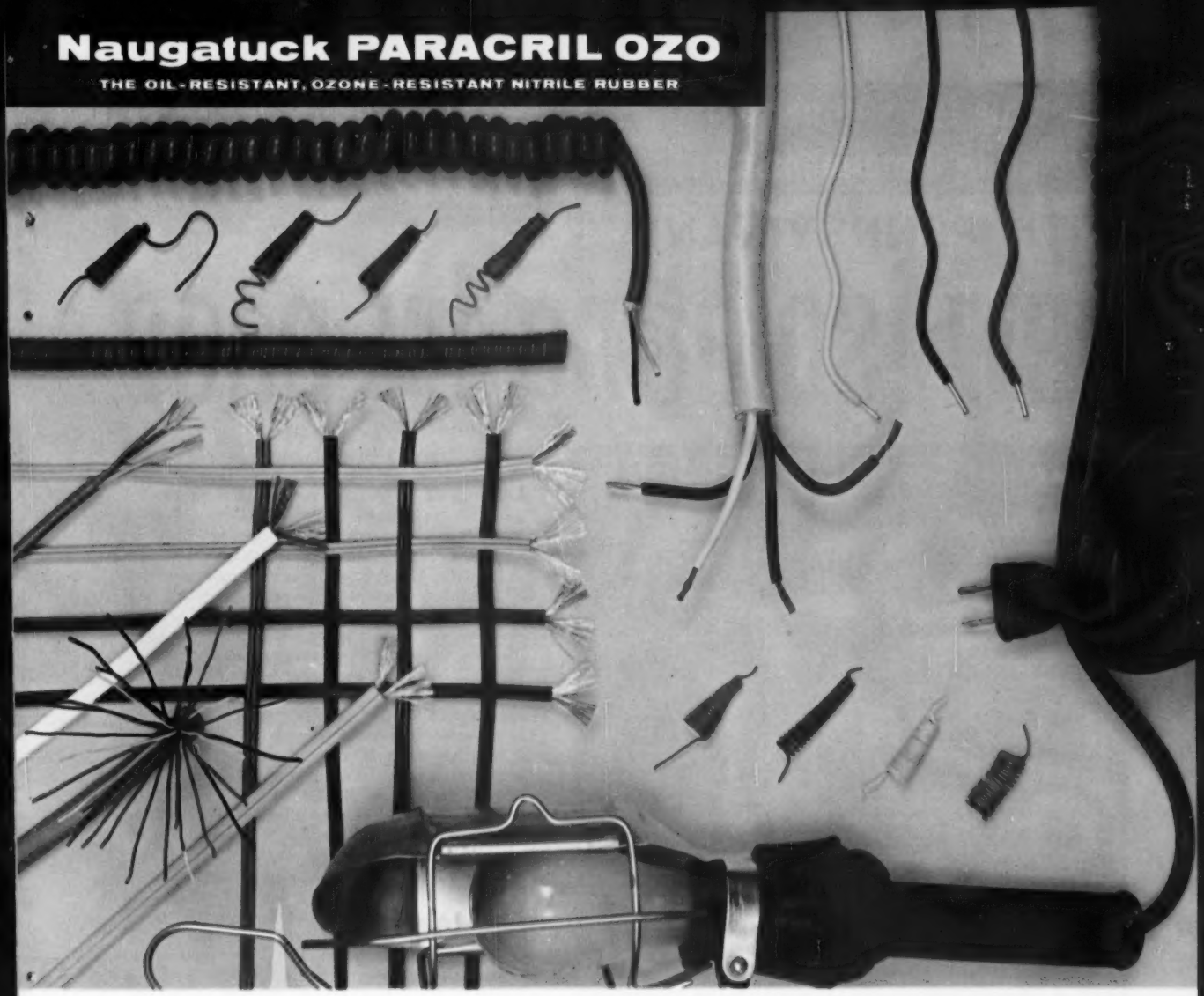
. . . **supplies air to personnel** in unventilated spaces, exhausts fumes and cools hot equipment. The type PT fan, which has a totally enclosed single or 3-phase motor, can be mounted in any position. The flexible duct is wire-reinforced. A 16-in. model, which delivers 4,150 cfm, and two 12-in. models are available.
Robbins & Myers, Inc, Springfield, Ohio.

Suspension Clamp . . .

. . . **for hot-line work** makes an intermediate link between clamp and insulator unnecessary. Simplicity of the all-aluminum side-opening clamp No. 5880 makes it fast and safe to install. It accommodates wire of 0.68 to 1.00-in. dia.
Lindsey Mfg Co, 222 Vista Ave, Pasadena, Calif.

Naugatuck PARACRIL OZO

THE OIL-RESISTANT, OZONE-RESISTANT NITRILE RUBBER



Great new advance in wire jacket rubber

Now you can give your wire and cable jacketing new resistance to cuts and abrasion, superior resistance to attack by oils and solvents, outstanding new resistance to weather and ozone . . . *and enjoy all the benefits of color, too.*

Color code for fast, unerring identification . . . color for smart, modern appearance . . . to call attention . . . to hide . . . to add solid new sales appeal. Because PARACRIL® OZO takes and retains any color you desire, permanently.

In addition to color, PARACRIL OZO offers such advantages as:

- significantly superior ozone resistance
- excellent resistance to fuels, oils, and solvents
- exceptional abrasion resistance
- high physical properties
- good flame resistance

Try new PARACRIL OZO. See why it offers makers and users of not only wire and cable jackets, but of rubber products by the hundreds a host of valuable new selling possibilities. For more information, for samples, for technical assistance with a present or proposed application, contact your Naugatuck representative or the address below today.

Naugatuck Chemical

Division of United States Rubber Company Dept. A Elm Street Naugatuck, Connecticut

US RUBBER

Rubber Chemicals · Synthetic Rubber · Plastics · Agricultural Chemicals · Reclaimed Rubber · Latices · CANADA: Naugatuck Chemicals Division, Dominion Rubber Co., Ltd., Elmira, Ontario · CABLE: Rubexport, N.Y.

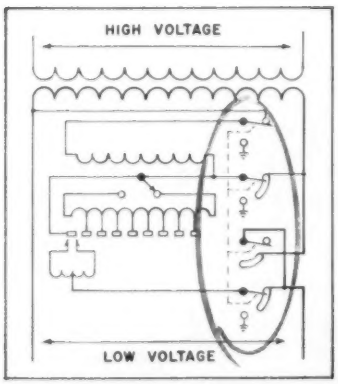
eliminate transformer outages . . .
save on LTC maintenance . . .

WITH PENNSYLVANIA'S

new isolating by-pass

FOR LTC TRANSFORMERS

Three-phase by-pass with a "550" LTC on the assembly rack being prepared for test. Operating handle of by-pass has key interlock to prevent improper operation. Switch position can be checked through sight-windows.



Typical connections for one phase of LTC by-pass switch assembly. Group-operated rotary switches are shown in normal operating position.

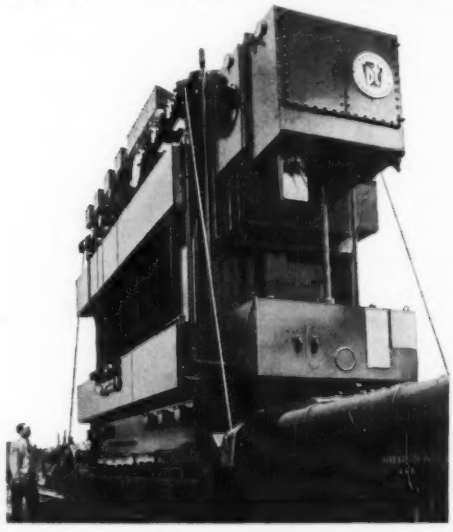
Periodic inspection and maintenance of load tap changing equipment is necessary, regardless of how good its quality. Since this work cannot be done on a conventional LTC transformer while it is energized, a costly outage must be arranged. This is not so when the LTC is provided with Pennsylvania's new by-pass facilities.

The integral by-pass assembly, originally developed for Pennsylvania's Phase-Isolated transformer, is a group-operated combination of by-pass, disconnecting and grounding switches. The LTC switches and mechanism can be completely isolated and grounded, permitting their safe inspection and maintenance *while the transformer continues to carry load.*

The proven operating advantages of the integral by-pass now can be secured with 3-phase LTC transformers of practically any kva and voltage rating. When compared to advantages gained, the cost of the addition is exceptionally small. For example, little more than $1,000 is added to the cost of a 10,000-kva unit.

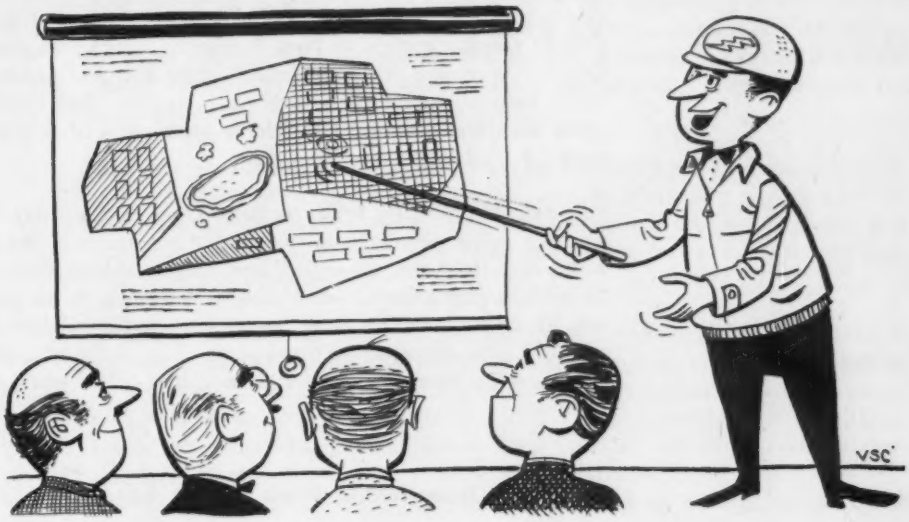
It will pay you in many ways to investigate Pennsylvania's integral by-pass switch. Consider it when *planning* your next LTC transformer installation. For further information, write to Pennsylvania Transformer Division, McGraw-Edison Company, Canonsburg, Pennsylvania.

McGRAW EDISON



LTC transformer with by-pass facilities, stripped of accessory parts and loaded for shipment to a Western utility. By-pass switch, in an independent oil-filled compartment, and its single operating lever, are located below the compartment for the "333" LTC Switch. The unit is rated 21,000/28,000/35,000-kva, Class OA/FA/FA, HV: 132,000GrdY volts, LV: 45,000 GrdY volts, TV: 6600△ volts, with plus and minus 10% regulation in 32 steps of ⅝% each.

PENNSYLVANIA LTC TRANSFORMERS



How CEI Helps Lure Industry

Report on
Area Development

How does a utility go about helping a community plan and grow without seeming to interfere in community affairs? Growth, after all, is a process outside of its immediate interests and jurisdiction. Is it possible to accomplish anything except getting the company in hip-deep trouble? Cleveland Electric Illuminating Co has made the attempt. The result, after four years of effort, is a major land-use study that communities themselves can use for planning the future of northeast Ohio.

The final product—a very attractive 106-page document—has been offered to regional and local planning groups as a tool for working out the region's destiny. Stress is placed on comprehensive treatment of areas suitable for industry in the future. Working on the theory that a planned industrial base will lead to a sound overall community, CEI planners ignored residential or commercial planning—the report concentrates on industry alone.

How did it get started? CEI's Area Development Department assembled much of the information as a byproduct of its own activities. Planners wanted to know exactly how much and where their zoned industrial land was. They discovered that there wasn't nearly as much "prime industrial" land available as they had thought. This makes it costly to supply power to the scattered segments and indicates some serious development problems for the future.

Further, they had experienced the common dilemma in industrial development of having the "big" one get away because the right land wasn't already zoned industrial. Industrial prospects don't want to get involved in a zoning hassle.

As are many utilities whose major service area is one of America's larger metropolitan complexes, the Illuminating Co is faced with one concentrated area of dense population and industry, and with mushrooming suburbs and exurbs. Because of haphazard development, many prime industrial sites have been chopped up for housing projects. Cuyahoga County, containing the city of Cleveland, needs, by CEI's estimate, 20,000 acres for industry in the future and has only a 16,300 acre ready potential. That's the hidden price of thousands of homes built on once prime

industrial land along rail lines, of other tracts of good industrial land now held for more homes, of "bowling alley" lots cutting once potential industrial acreage into fragments.

And Cuyahoga County can't go it alone. The most urban, most crowded county may not have enough good industrial land for its desired future and may not be able to reclaim enough to meet a growing deficit. Regional cooperation with neighboring counties will be essential. These have some land beyond their evident future industrial needs near Cuyahoga's borders. And Cuyahoga has water and sewer lines that could be extended to serve parts of neighboring counties. The need for such cooperation is evident.

CEI estimates that, by 1980, northeast Ohio must provide at least 20,000 more acres for industry to maintain an expected population of three million people; and in the next 100 years, the region must provide at least 90,000 industrial acres for an ultimate population of seven million. Returning to the present, northeast Ohio now has only 6,000 acres zoned for industry, readily buildable and easily accessible, of its 125,000 potential industrial acres. This could be enough to accommodate the region's industrial growth for the next four or five years, if no acres are lost to other uses.

CEI Does Groundwork, Finds Choice Sites

Map review and quick field trips helped in selecting 300,000 acres near railroads, freeways, and Lake Erie for detailed study through data gathered by: (1) Plotting present land use from maps, air photos, and field inspection, (2) Recording property lines and ownerships, (3) Plotting sewer, water, gas and electric service areas, (4) Analyzing terrain, soil structure, and drainage, (5) Outlining areas zoned for industry.

Four basic precepts were followed to guide data gathering, study and analysis:

• Because adequate land for industry is essential to regional well-being, identification of prime industrial land potential early in the regional planning process is of first importance.

• Only land for which industry is the best use should be designated for industry. Not every plot of land that could be used for industry must be so used—only enough of the best quality land to accommodate anticipated industrial growth.
• Industry should be clustered as much as possible into large industrial working areas of regional significance, not scattered about in a hodgepodge of little pockets.
• Industry belongs only where all criteria for its optimum development are or can be met. The criteria: Compatible uses nearby, zoned for industry, few steep slopes, all utilities available, drainage feasible, subsoil stable, ample access by rail and highway, for sale at a reasonable price.

Data analysis determined which land was best for industry from a regional viewpoint. Then tentative outlines of desirable industrial areas were plotted, sketched and reviewed with experts. Trial plans were revised and reviewed with the area planning agencies. Only then were final conclusions drawn, findings tabulated, and the report produced.

Seventeen special analysis areas, totalling the 300,000 acres, are considered as separate units and are made up so that just those sections may be distributed in the communities involved. Analysis area boundaries were devised after reviewing land near railroads, freeways, and Lake Erie. Then geographically logical territories were outlined without regard to local political boundaries. Names were chosen to identify the location and character of analysis areas in terms of well-known communities or major features, such as a river, railroad, or geological characteristics—or simply coined for local "color" or conveniences.

Detailed analysis area facts are presented in individual four-page sections. Page one of each section highlights that area's location and key features. Page two of each section contains detailed text on present development, zoning, terrain, geology, drainage, utilities, access and land ownership and also outlines industrial plan suggestions and development opportunities. Page three presents these industrial plan facts in map form. And page four points up an industrial planning concept well illustrated by specific factors in the area.

. . . But It's Up to Townspeople to Lay Firm Plans

"We know there are going to be disagreements. We expect them. And that's all right"

CEI has stressed that the survey is not a proposed blueprint for a plan of action. It feels that it would be presumptuous to attempt to tell the people of the various communities what they should do with their land. Already, many requests for copies of the study have been received from village, city, and township planning agencies. CEI hopes to maximize understanding and agreement and minimize the difficulties in planning in the service area.

A spokesman points out, "We know there are going to be disagreements. We expect them. And that's all right. We don't expect everyone to accept our ideas without questioning them. But in the process, local people will be able to understand our efforts and realize the need for sound development."

Karl H. Rudolph, CEI vice president, marketing, notes, "The initial response to our 'More Land for Industry' study has been extremely gratifying. We have distributed, upon request, 57 completed copies of the study since it was first introduced publicly in early June. These went to city and county planning commissions and planning groups. In addition, we have presented to other city and county planning officials the pages of the study which pertain to their own localities.

"Our primary interest has been, and is, not to beat the drums for any specific plan or plans, but rather to create a much more acute awareness of the need for planning, and especially long-range, broad-scale planning. I think we can measure the success of the study in terms of the keen interest civic and planning officials have shown in it and by the increasing number of requests we receive almost daily for a copy or pages of the book."

E. E. Gayman, general supervisor, community development section, adds, "We have received and continue to receive a number of requests for a copy of the study from cities and agencies outside CEI's service area. A recent example is a request from the City Planning Commission of Detroit."

Most Utilities Shun Active Planning Work

Very few utilities have ventured actively into the planning field. It is usually considered unnecessarily provocative to involve the utility in controversial community activities and, in the bargain, expose it to a number of eager snipers. There's no denying that almost any zoning activity makes some enemies. And it certainly can be argued that municipal planning and zoning is just none of the utility's business.

There are, however, positive aspects. A city service area with the benefit of sound, long-range planning is certainly desirable for the utility's best interests. Also, urban planning is undeniably growing in stature and interest in all sections of the country. Democrats have advocated in their party platform that a new cabinet post be carved out to include this field.

In the formative stages, at least, fledgling city planners will welcome trained assistance, from the utility company or anyone else, as long as no pressures are applied to force the adoption of outside points of view. The utility company has this reservoir of personnel and information. Its prosperity is inextricably bound up with the prosperity of the area it serves.

Can expenditure of company funds be justified for this sort of operation? It has been pointed out in the past that area development is as important to the utility as sales programs are. Participation in municipal affairs can make enemies, all right. CEI expects that it can make friends too.

WESTINGHOUSE POWERCASTING* initiates 3 broad EHV transmission programs

predicts conquest of major problems blocking economical use of high voltage

Extends massive investigations of the last 13 years . . . helps utilities hold investment costs down

How to invest 30 billion dollars? POWERCASTING can help

Over the next 20 years, the electric utility industry will make a transmission system investment of 30 billion dollars. Much of it will be in extra-high voltage . . . because it will be technically and economically necessary to do so.

To invest on this scale in EHV systems will require a high order of long-range planning—to anticipate the right problem, make the right decisions, at the right time.

Westinghouse POWERCASTING is available to you today to do this planning-ahead job . . . to do it thoroughly and with scientific accuracy. POWERCASTING, through broad system investigations and problem solving, can help you plan your transmission system expansion . . . economically, and now.

POWERCASTING continues to search problems for solutions . . . to accelerate Westinghouse lead in EHV research

Westinghouse is currently attacking three primary problem areas:

1. Radio influence and corona loss.
2. Lightning flashovers.
3. Switching surges.

Important new programs are underway in these areas.

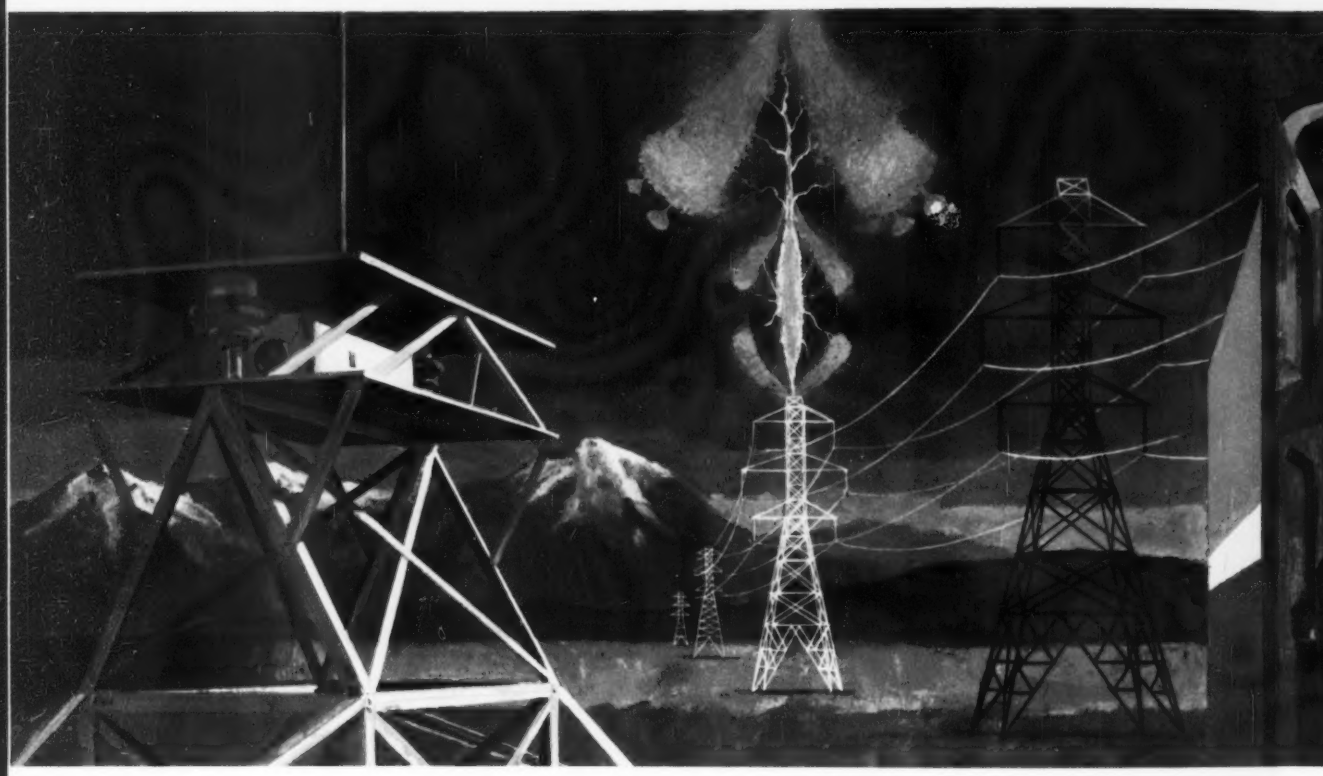
EHV research is not a new area for Westinghouse. The current programs are based on broad investigations that began as far back as 1947. The Tidd project, begun in that year with the American Electric Power Company, proved that transmission voltages up to 520 kv could be reliable and practical.

*A Service-Mark of Westinghouse

YOU CAN BE SURE...IF IT'S **Westinghouse**

WESTINGHOUSE POWERCASTING*

joins with high-voltage studies to



The Leadville tests, begun in '56 with the Public Service Company of Colorado, are providing valuable data on performance of EHV lines at high altitudes.

These studies provided much of the technology for building today's EHV lines.

1. New Westinghouse test line probes secrets of radio influence and corona loss at higher voltages

A third intensive Westinghouse study of R.I. and corona is now underway.

At Trafford, Pennsylvania, Westinghouse is building a special line to study fundamentals of corona formation, generation and control of R.I. and the development of new measurement techniques. The knowledge gained from this test line will be applied in a new large-scale test program.

These studies will permit the design of EHV lines above 500 kv when POWERCASTING indicates their need.

2. The lightning surge problem...Westinghouse Prestrike Theory

From intensive studies of the lightning stroke mechanism, Westinghouse has evolved the new and revolutionary Prestrike Theory. According to this theory, the tip of the lightning leader contains a large charge which is rapidly injected into the transmission tower. The result is a high-magnitude, short-duration current —prestrike current—producing very high voltages across the insulator string. The prestrike current will account for the higher-than-predicted outages on certain designs of EHV lines.

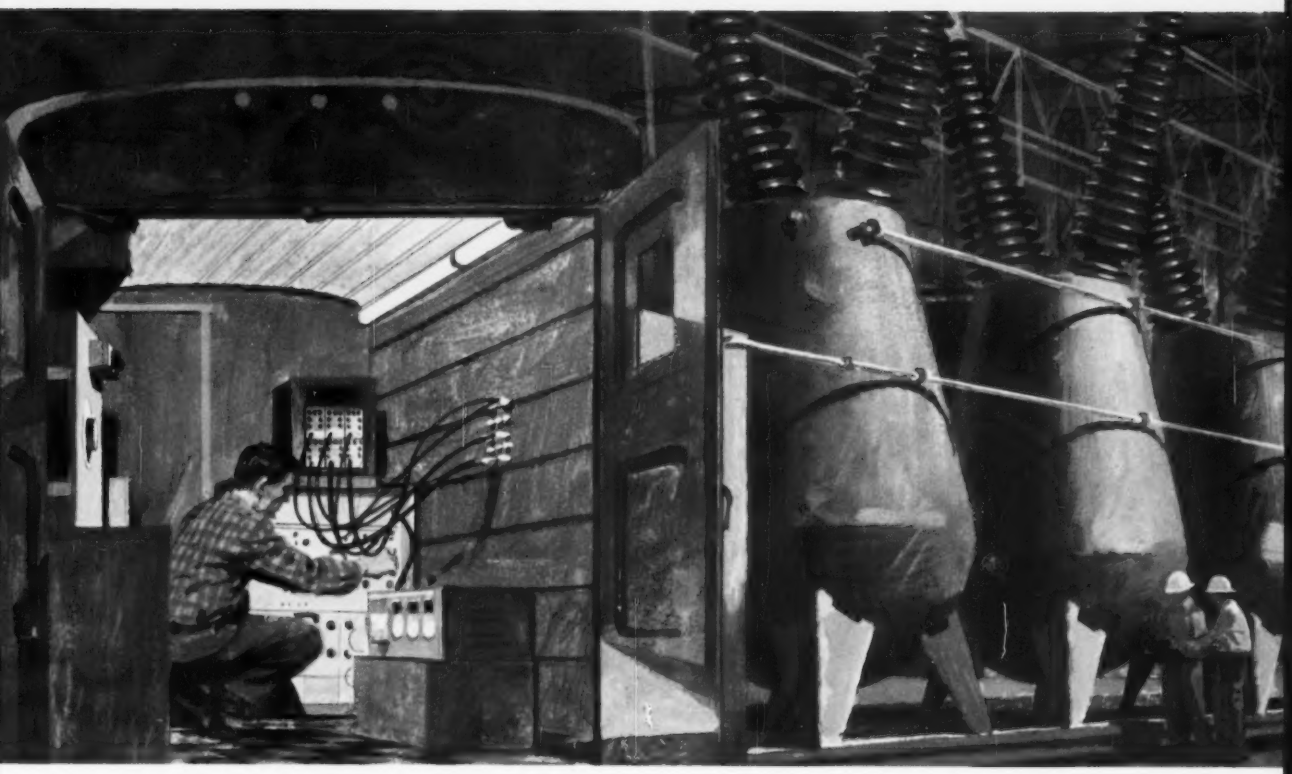
To determine the existence of the prestrike . . .

Westinghouse developed unique current-time measuring instrument, the Kine-Klydonograph

The KINE-KLYDONOGRAPH is one of the many unique instruments developed by Westinghouse to probe the secrets of lightning. It is capable of accurate measurement of the current wave shape of a natural lightning stroke over a wide time range—0.05 to 15 microseconds. The records from these instruments will verify if the prestrike does exist.

The Kine-Klydonograph is mounted atop the transmission tower. Since June of 1959, 20 such instruments

facilitate economic growth of EHV lines



have been installed on a 345-kv line, and an additional 60 instruments are being installed this year.

Westinghouse is currently focusing attention on these critical characteristics of lightning. These investigations will lead to more realistic line and equipment design and to more reliable EHV transmission.

3. Westinghouse–AEP, in two-year field test program, to make extensive study of switching surge problem

Early 1960 will see initiation of the first comprehensive survey of switching surges ever undertaken on an American utility system. Results of this survey will significantly influence the design of future higher voltage systems. The paramount insulation coordination problem for substation equipment is protection against switching surges rather than lightning.

Westinghouse and American Electric Power are cooperating in this study to measure system voltages and currents under a variety of transient conditions—line dropping, line energizations, magnetizing current interruption and de-energization, etc. Measurements will be made on 345-kv and 138-kv circuits. Total activity will involve more than 40 major field tests.

Two areas into which these test results will flow are transformer and switchgear design. Wave shape and frequency of surges are required to determine switching surge strength and BIL. Very little field data is available on switching surges which transformers may encounter. Most information on magnitude and frequency of surges has been determined by analog computer studies. Ideally, computer studies based on field test data promise the most realistic results.

New tools and new techniques have thus been made available to Westinghouse POWERCASTING . . . a program to unearth new knowledge. In this carefully balanced study program, Westinghouse will reduce present problems to a fuller understanding of switching surges . . . leading to system design ideas that will lower utilities' EHV transmission investment.

*A Service-Mark of Westinghouse

YOU CAN BE SURE...IF IT'S Westinghouse

WESTINGHOUSE POWERCASTING*

can help you plan your system expansion ...economically, and now

Westinghouse POWERCASTING is a two-fold plan of action, designed to meet the modern problems of the industry.

HERE'S HOW YOU AND YOUR CONSULTING ENGINEER CAN PUT WESTINGHOUSE POWERCASTING TO WORK

At your request, Westinghouse will

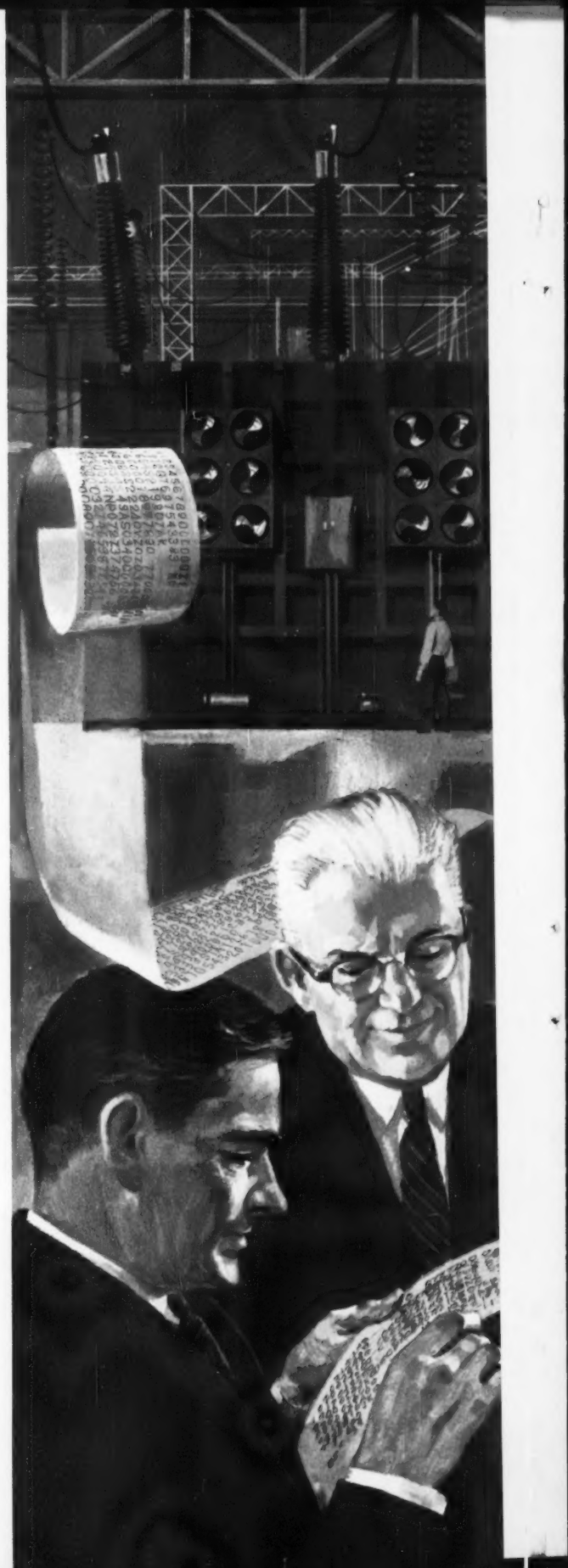
. . . Send a qualified POWERCASTING team to your office.
. . . Help you outline problems and objectives of your system.
. . . Arrange a seminar to detail project specifications.
. . . Build a mathematical model of your system.
. . . Program your future system needs and equipment investment.

Only Westinghouse offers you POWERCASTING

1. A technique for more accurate planning of future system expansion.
2. A program of product development for generation, transmission and distribution geared to the needs of future systems.

*A Service-Mark of Westinghouse

YOU CAN BE SURE...IF IT'S Westinghouse



CP-1056

Litho in U.S.A.

GOLD MEDALLION Homes were visited by 45,000 people in 8 days. Each was given a brochure with detailed information on each house

All Electric Homes Sell Well

West Virginia builder finds heat pump homes sell even in highly competitive area. Plans 180 in all

Selling Gold Medallion Homes in a highly competitive area with abundant gas resources is not the easiest thing to do. But builder Mel Wright in Huntington, W. Va., has done just that and he's pleased with the results.

And, until this project, Wright had never built an electrically heated home.

The $8-million subdivision, which will have 180 residences on completion, has only Gold Medallion Homes.

Why did builder Wright choose the Gold Medallion standards?

"To be a success, a development of this type (the homes are in the $20-55,000 class) has to be all-electric," he said. "It has to feature the heat pump because buying a home today without central air conditioning is like buying a car without power steering or power brakes."

He also explained that where air conditioning and heating can be combined in one unit, it is more practical and profitable for the builder and the buyer.

"I haven't built electrically heated or air conditioned homes before, because I didn't think the market was ready," he explained. "Now, however, I feel the initial success of Arlington Park development speaks for itself."

What was this success?

Wright has agreed to hold open houses in 34 speculative Gold Medallion Homes this year, 22 more than originally planned.

Last month the first Parade of Homes was held. Crowds were estimated at 45,000.

On June 18, one day before the public announcement, Wright had contracts for 21 GM Homes. This was accomplished through-word-of-mouth and contacts by his two salesmen. By July 18, 37 homes were sold and the "very good prospects" list was growing rapidly. The first six sales were closed primarily because the homes featured heat pumps and were totally electric.

How was the builder sold on the Gold Medallion concept?

Mainly through the persistence of the Appalachian Power Co. Said G. C. Everett, residential and rural sales supervisor for the Huntington Division, "Several times before, we had presented Mr Wright with our standard builder cooperative program, but although he seemed interested we were never able to get him to go ahead with a speculative home.

"It was only after we held a contractors' clinic on resistance heating, heat pumps and our allowances that Wright first showed interest. He approached us and outlined plans for a 50-acre subdivision in which he wanted to build some heat pump homes."

The power company then moved into action. It presented its program on Gold Medallion Homes, explaining the important features which would help sell the homes, and pointing out the allowances for advertising and heat pumps, ranges and water heaters.

Look Magazine's special builder's promotion, "Brochure Power," helped sell Wright. The brochure, which is personalized for the builder, and is passed out at open houses, contains information on the power company's part in the promotion, who the homes' suppliers are, and detailed information on each house.

As a result of these efforts, Wright agreed to build 12 speculative Gold Medallion Homes the first year.

Sales Allies Enter Picture

Next, heat pump and appliance dealers entered the picture. Also, more contacts with *Look* representatives were arranged. As a result, Wright agreed to put heat pumps in the first six homes.

As his enthusiasm welled and manufacturers and suppliers indicated more support, Wright said he would begin in an all-electric subdivision and would continue to build heat pump equipped homes until he met-buyer-resistance.

He hasn't met it yet.

A key part of this promotion was the part the power company played.

(*Continued on page* 68)

MEDALLION HOME
LIVE BETTER ELECTRICALLY
by GENERAL ELECTRIC
WITH LIGHT FOR LIVING
HEATING and COOLING
KITCHEN and LAUNDRY
FULL HOUSEPOWER

Read why builders are

From coast to coast, builders, like the four shown here, are discovering exciting new sales allure in Medallion Homes equipped by General Electric. Here's what makes a Medallion Home: 1. At least four major electric appliances; 2. Eye-saving lighting properly located throughout the home; 3. Full housepower with wiring planned for all present and future electrical needs; 4. And in addition, Gold Medallion Homes have electric heating. You'll find this foursome adds up to the biggest selling combination since plumbing moved indoors.

HOUSTON, TEXAS

"Naturally a home like the Steiningers' is easier to sell," says John D. Townshend, the builder of the Don Steiningers' house shown here. "Down here, air conditioning is a must. But when you take a home like this one, with its Weathertron heat pump, you've got a natural. People go for a one unit heating-cooling system like the General Electric Weathertron." Mr. Townshend has found that a Gold Medallion Home simplifies financing, too. "Because they know it isn't about to go out of style, bankers are favorably impressed by these homes."

ROSLYN, LONG ISLAND

"Women just can't resist a house with a kitchen like this one," says Kalman Klein, builder of more than 7000 Long Island homes. He has found the highest public response to General Electric products. "And once they've moved in, people like Mrs. Simon (shown with her daughter) appreciate the dependability of General Electric equipment. That's why we started using General Electric appliances," he says, "and believe me, that's why we've stayed with them. People just naturally want a name they know and trust."

building Medallion Homes everywhere

SANTA ROSA, CALIFORNIA

Lewis Meyers, who began to use General Electric equipment more than six years ago, explains why he continues to build General Electric equipped homes: "It couldn't be simpler," he says. "I stay with them because they're up to date, because they have the best service and because my customers like their reliability." The living room of Dr. and Mrs. Walter Weber shown here is part of a model home built by Mr. Meyers to illustrate light for living. "It was so successful," he says, "I'm starting another model home next week."

DELMONT, PENNSYLVANIA

The warm comfort of General Electric ceiling heat is illustrated here by the family of Mr. and Mrs. Adam Ardisson. Louis Meneghin, who built the Ardissons' Gold Medallion Home almost two years ago is presently building several more in the Delmont, Pennsylvania region. "I see it as the coming thing all over the country," he says. "More people are becoming more aware of electric heating every day. I expect to build a lot more Gold Medallion Homes around here. And one thing, for sure . . . they'll be equipped by General Electric."

For information on the "Electrical Heating Institute" that General Electric has prepared for use by utilities, write for Pub. No. 49-517 Rev., The General Electric Company, Electric Comfort Heating Section, Appliance Park, Louisville 1, Kentucky.

Progress Is Our Most Important Product

GENERAL ELECTRIC

LOOK—NO FINS!

FOR EASIER INSTALLATION, DELTA-STAR ELIMINATES FINS ON DISTRIBUTION TRANSFORMERS THROUGH 50 KVA

Elimination of cooling fins has made Delta-Star distribution transformers more compact—easier to handle and install. On all sizes through 50 KVA, weights and basic tank dimensions match competitive models. The big difference is that Delta-Star transformers save the bulk created by fins or tubes.

Elimination of cooling fins on Delta-Star transformers follows several years of evaluating the thermal characteristics of the transformers. The Delta-Star design eliminated excess heat—heat that the tank alone cannot dissipate. With no excess heat, there is no need for the cooling capacity provided by fins or tubes.

Delta-Star Distribution Transformers provide high efficiency and good regulation, as well as ease of installation. For complete information, on these cost-cutting transformers, write to *Delta-Star Electric Division, H. K. Porter Company, Inc., 2437 W. Fulton St., Chicago 12, Ill.*

DELTA-STAR PORTER ELECTRIC DIVISION

H. K. PORTER COMPANY, INC.

PORTER SERVES INDUSTRY with steel, rubber and friction products, asbestos textiles, high voltage electrical equipment, electrical wire and cable, wiring systems, motors, fans, blowers, specialty alloys, paints, refractories, tools, forgings and pipe fittings, roll formings and stampings, wire rope and strand.

Gold Medallion Homes

(*Continued from page* 65)

Its program was divided into two phases. Phase one: Allowances and cash benefits. These included allowances for each heat pump, range and water heater installed, and an advertising allowance for each speculative open house.

Second phase: The promotion of the development. This included: Individualized *Look* brochures handed out during the open house; radio interviews with prospective buyers; company advertising, including Gold Medallion tie-in newspaper ads, and radio and TV commercials; demonstrations by heating and home service representatives during the open houses; and cooperating in the cost of a lighted outdoor sign which was visible from the highway.

Appalachian representatives were on hand to answer questions. Sales allies such as flooring, appliance and insulation representatives were there.

In fact, no detail was overlooked. For those viewers who brought children, the contractor provided a supervised playground.

SELLING BRIEFS

Full-color sound movie on **electric heating for schools** has been issued by Edwin L. Wiegand Co. "Electric Heating Goes to School" is true story of a school board's choosing electric heat. Film directed at school board members, architects, and consulting engineers. Available on loan from Edwin L. Wiegand Co, 7500 Thomas Blvd, Pittsburgh 8, Pa.

More than 7,500 homes will be **heated electrically** by 1970 on the lines of the Western Massachusetts Co, according to Howard J. Caldwell, president. At present there are 350 electrically heated homes, with 500 expected at year's end.

Electric unit heaters for office, store, institutional and industrial installations has been introduced by Westinghouse Electric Corp. Units are available in 1½ to 36 kw with either manual or automatic control.

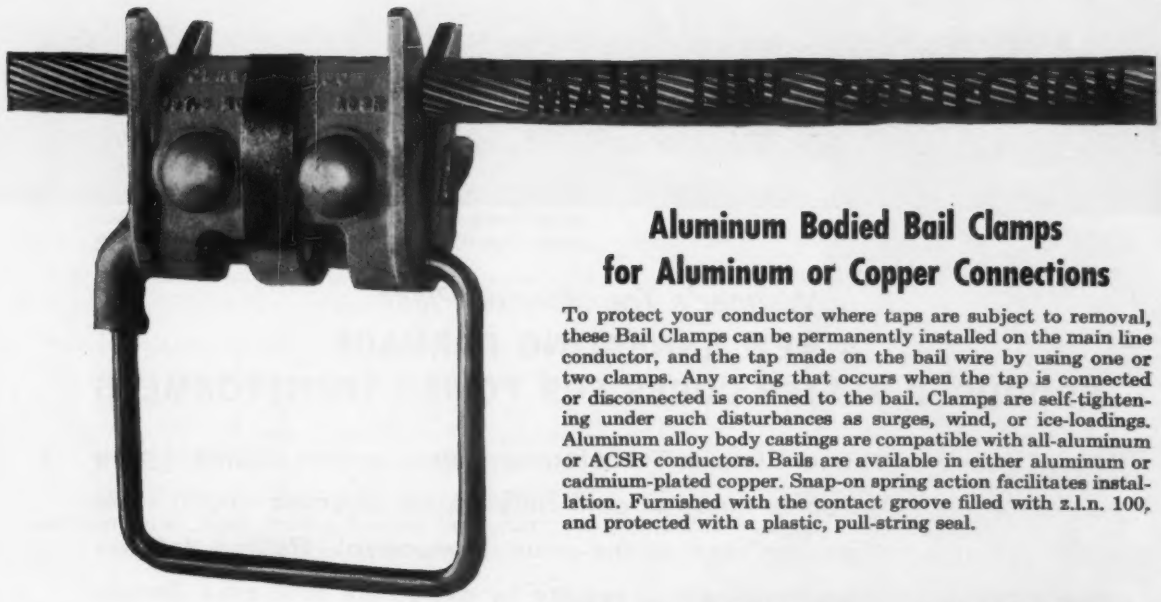
CHANCE Clamps for Big Conductor

Built for Heavy Duty

These All-Aluminum hot line clamps combine several advantages for heavy duty line construction. Their bulk gives them both the mechanical strength to withstand extreme tightening torque without distortion, and the ability to carry excessive current without heating.

The fact that all exposed surfaces are aluminum makes them the clamps to use in corrosive areas where other clamps might fail. Their conductor range for both main line (No. 2 to 397.5 MCM ACSR) and jumper (No. 4 Solid AWG to 397.5 MCM ACSR) makes them versatile clamps for many applications.

Important from the conductivity standpoint are the wide jaws with special "waved" contact surface, and the heavy terminal pad. To further insure good conductivity, these clamps are available individually packaged in polyethylene bags with Chance z.l.n. 100 Electrical Contact Aid pre-applied to contact surfaces. Price per clamp in lots of 100, $2.65. AGP (fortified cadmium plated) packaged clamps are also available, at $2.90.



Aluminum Bodied Bail Clamps for Aluminum or Copper Connections

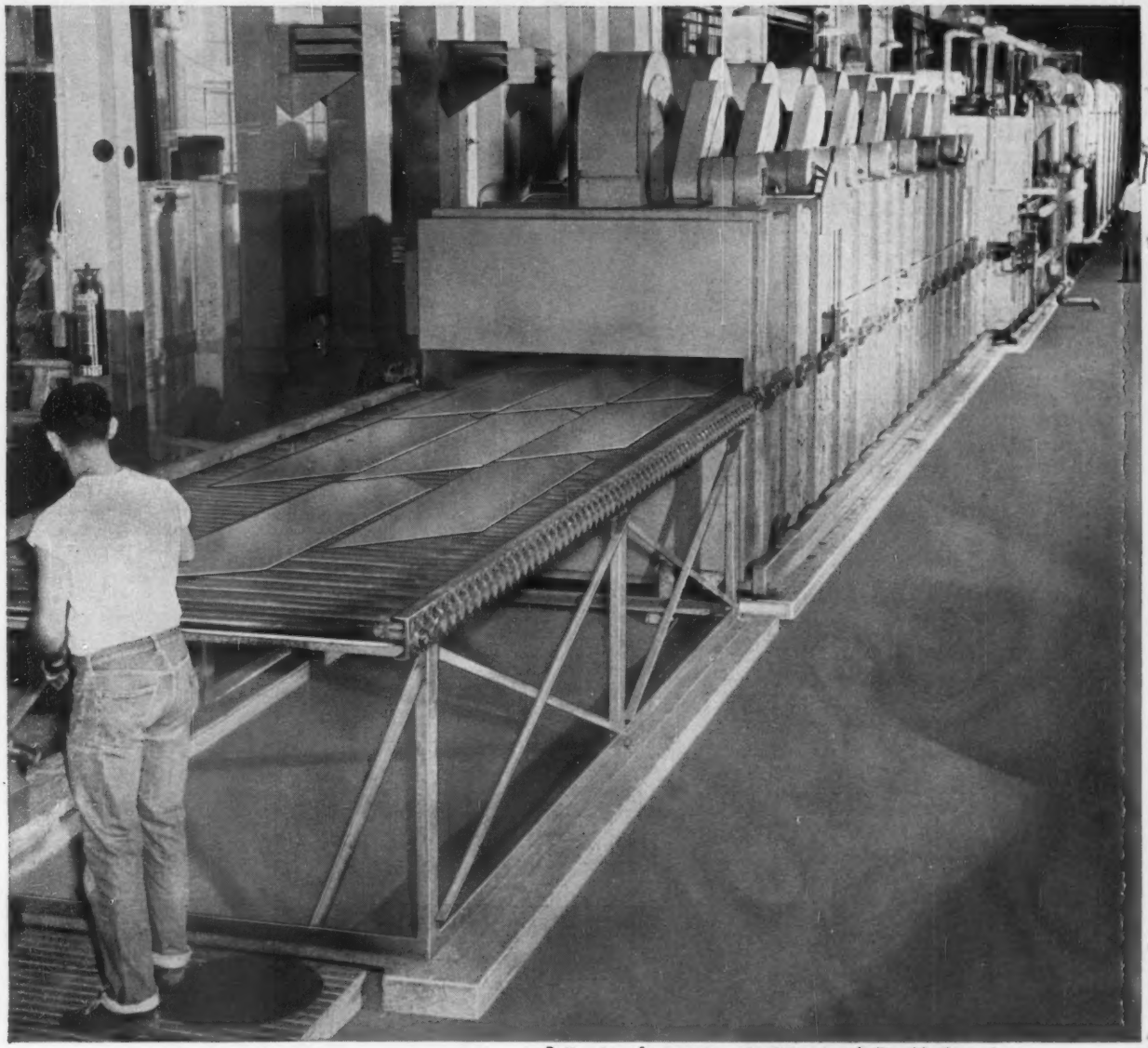
To protect your conductor where taps are subject to removal, these Bail Clamps can be permanently installed on the main line conductor, and the tap made on the bail wire by using one or two clamps. Any arcing that occurs when the tap is connected or disconnected is confined to the bail. Clamps are self-tightening under such disturbances as surges, wind, or ice-loadings. Aluminum alloy body castings are compatible with all-aluminum or ACSR conductors. Bails are available in either aluminum or cadmium-plated copper. Snap-on spring action facilitates installation. Furnished with the contact groove filled with z.l.n. 100, and protected with a plastic, pull-string seal.

A. B. CHANCE COMPANY

CENTRALIA, MISSOURI

(A. B. Chance Company of Canada, Ltd., Toronto)

CC60-22

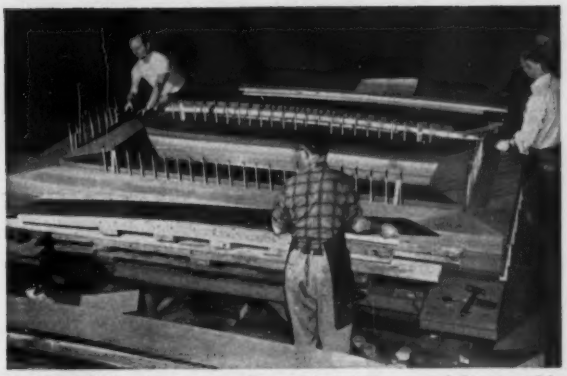


Better transformer core structures are built with the uniformly annealed laminations produced by this new furnace.

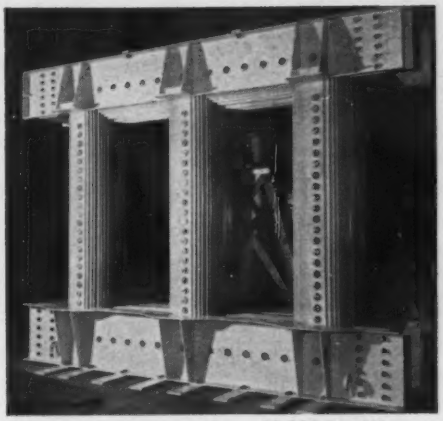
In Wagner's Transformer Plant...

A NEW ANNEALING FURNACE PRODUCES BETTER CORES FOR POWER TRANSFORMERS

Now, in every Wagner® Power Transformer, there's a new, compact core structure: mitered cores made of cold-rolled, grain oriented silicon steel that greatly reduce the across-the-grain component. Rolling follows the direction of the flux path... results in extremely low core losses and low exciting current.



Highly skilled Wagner transformer technicians carefully assemble core laminations after they come from the continuous annealing furnace.



Split-type 3 phase core for a 60,000 kva Wagner Power Transformer.

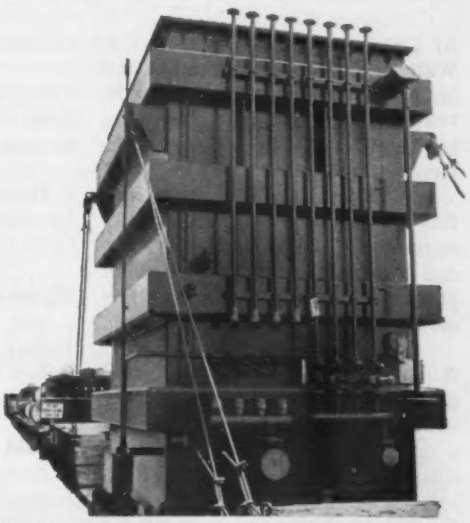
Continuous annealing of laminations enables us to make the most of these improvements in core steel and core design. Each individual lamination moves through automatically controlled heating and cooling chambers in our modern, continuous roller hearth furnace before being assembled into transformer cores that conform to the industry's highest standards.

This uniform annealing process relieves stresses so evenly that edge and ripple factor is extremely small. The annealed laminations are perfectly flat . . . practically free from stresses that affect magnetostriction and permeability. This flatter steel makes it possible to build tighter, more compact, virtually vibration-free core structures; minimum sound levels are achieved. And, the mitered core design substantially reduces across-the-grain losses and ampere-turn exciting current for peak electrical performance.

This new furnace, put into service a year ago, effectively cuts annealing time from days to minutes . . . produces highest quality, ready-to-use core materials at a rate that greatly reduces the time needed to manufacture finished transformers.

The performance stability of Wagner® Power Transformers is outstanding. But, this stability is just one part of the story . . . quality is designed and built into every part of each transformer by specialists with years of engineering and production experience. Why not consult us about your power transformer requirements? Your nearby Wagner Sales Engineer is at your service. Call him . . . or write us.

Mitered core construction greatly decreases across-the-grain component. Rolling follows direction of flux path.



Another quality Wagner Power Transformer begins its journey to the installation site.

WT60-15

Wagner Electric Corporation

6456 PLYMOUTH AVE., ST. LOUIS 33, MO.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Calgary Power Elects Thompson President

G. H. Thompson has been made president of Calgary Power Ltd. G. A. Gaherty became chairman of the board and A. W. Howard, vice president.

Thompson joined Calgary Power in 1925 and became chief engineer shortly thereafter. He was appointed general manager in 1931, and became vice president in 1941. He is also a director of the company.

Gaherty first became associated with the company in 1920. In 1923 he was appointed chief engineer and general manager, and was then named president in 1928. Among other companies, Gaherty is a director of Atomic Energy of Canada Ltd.

THOMPSON GAHERTY HOWARD

Howard joined the utility in 1935 as an electrical engineer. He became manager in 1952 and a director four years later.

Combustion Engineering Names Gross VP

Lambert J. Gross has been elected vice president and treasurer of Combustion Engineering, Inc. He succeeds Otto W. Strauss who will continue as a vice president of the company until his retirement in October.

Gross was formerly vice president-finance, treasurer and a member of the board of management of General Dynamics Corp. He joined General Dynamics as comptroller in 1947 and was named a vice president in 1951.

A graduate of Princeton University, he received an MBA from New York University's School of Business Administration.

PERSONAL BRIEFS

At Oklahoma Gas & Electric Co. **William H. Mapes** has been named industrial sales manager; **Herbert R. Winters,** general office power sales engineer, replacing **Thomas E. Graham,** retired; **A. W. Weigl Jr** to Central Division sales supervisor; **Bill Joe Cowan,** commercial sales engineer for the Southern Division, and **Robert H. Smith,** supervisor of personnel records, replacing **Harmon R. Williams** who died recently.

R. W. Butts has been appointed general supervisor of residential sales for Ohio Edison Co, to head up a new activity stepping up electric house heating promotional activities.

Donald M. Jones has been named executive secretary of the Public Utilities Assn of the Virginias.

Vice President **John E. Logan** has been elected a director of Jersey Central Power & Light Co.

J. Harvey Leach, Western Division Manager of Puget Sound Power & Light Co, has retired.

Richard D. Wilhite has been named a vice president of Rockwell C. Tenney, utility managers in Boston. **Robert A. Ferreira** is the new assistant treasurer.

Donald A. Gray has been promoted to assistant commissioner and chief engineer in Denver, Colo., for the US Bureau of Reclamation. **John S. Hamilton** has replaced him as manager of the Bureau's Klamath Project in Region II.

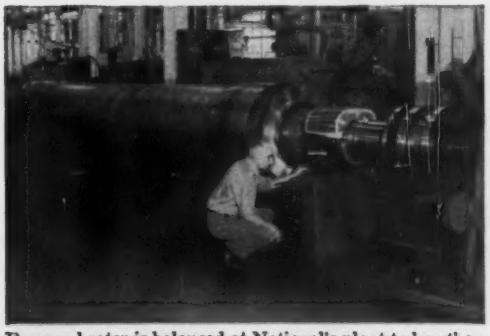
West Penn Power Co has promoted **Anthony A. Jedrziewski** to supervisor of lines engineering, succeeding **Roscoe C. McKee,** retired.

Burdette A. Johnson, treasurer, New England Gas & Electric Assn, has been elected a vice president of the Controllers Institute of America.

William D. Webb has been advanced to secretary of Kansas City Power & Light Co, and **Richard E. McLeod,** assistant secretary.

Floyd M. McDowell has been named merchandise sales supervisor for Potomac Light & Power Co.

Thermal cycling ruined it...



Rewound rotor is balanced at National's plant to less than .0005" motion in free floating bearings. After complete testing, rotor was returned to service.

National rebuilds 63,333-hp rotor to last

This rotor for a wind tunnel motor took unusual punishment. Since loading of the motor continually changed, the rotor was subjected to severe thermal cycling. Expansion and contraction of coils in the slots broke down the mica ground insulation.

National rewound the rotor with new coils insulated with glass-fiber and resin. New design slot troughs of high mechanical strength were used. Now the insulation wall is extremely tough, solid and durable.

Whether your electric coil and rebuilding needs are standard or special, you'll be sure of performance when you call in National Electric Coil. We tailor-make the coils to fit your needs; offer all types of insulation. For information call National's Columbus plant... HUdson 8-1151 ... or call the nearest National field engineer.

NATIONAL COILS

National Electric Coil

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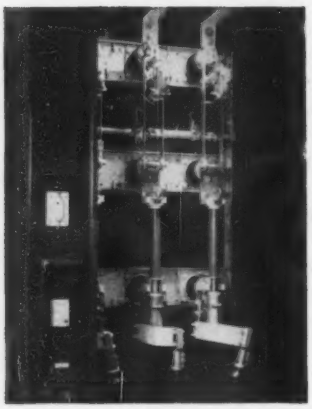
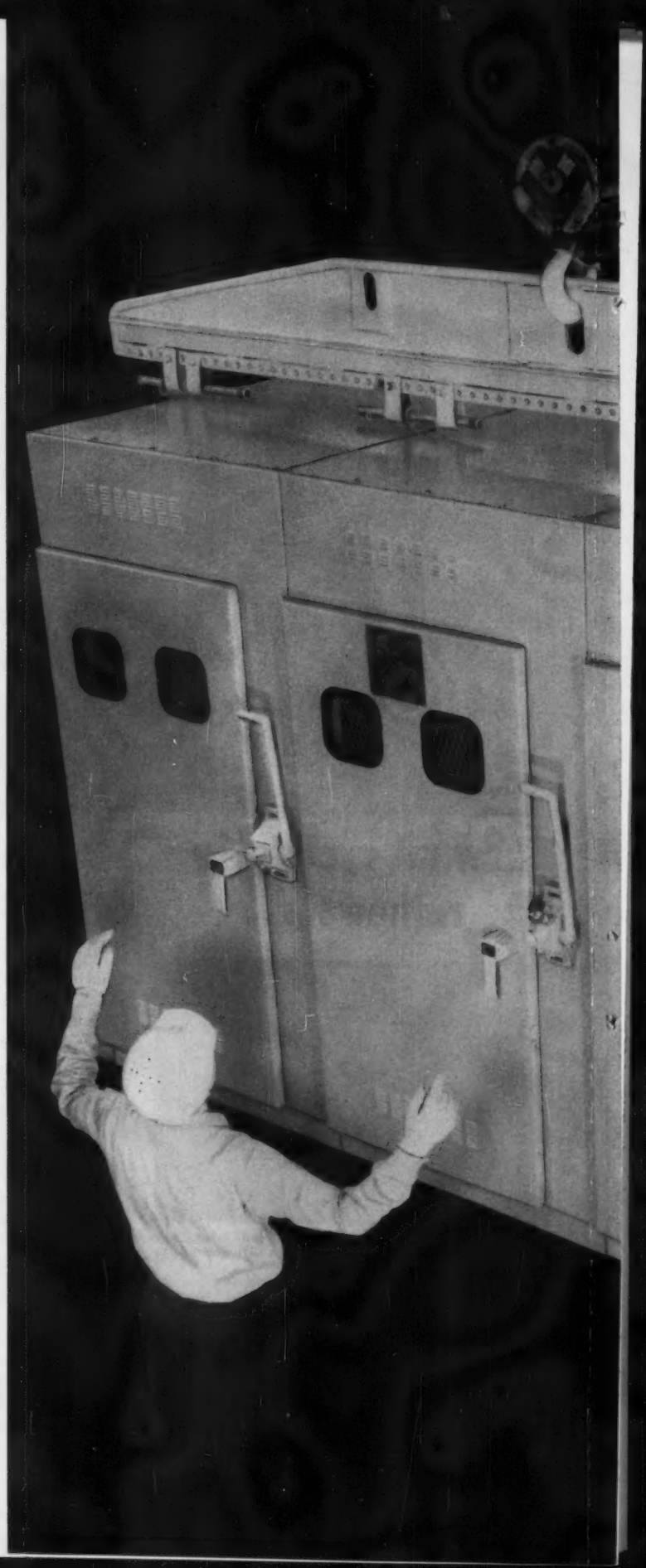
DIVISION OF McGRAW EDISON

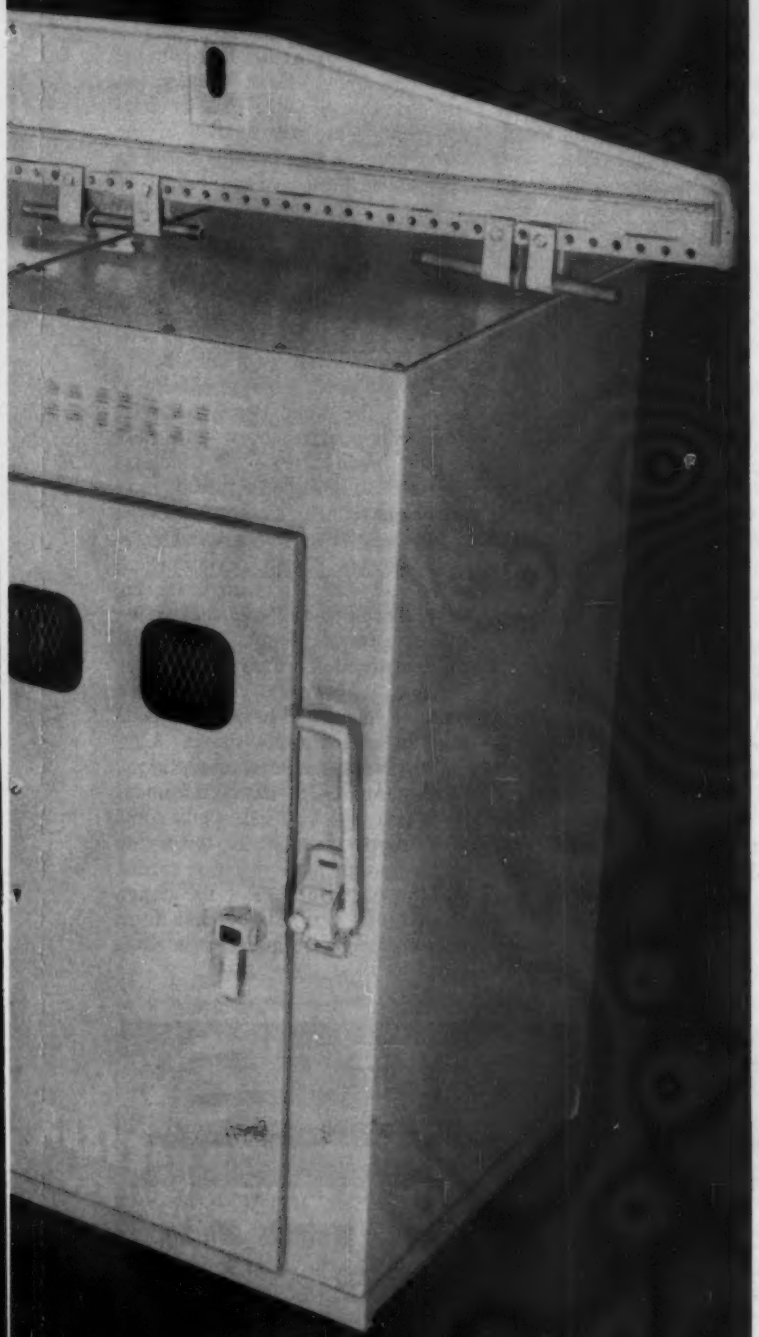
FAULT PROTECTION

ONLY 125 LB. PER SQ. FT.



Inside view of typical bay, showing load interrupter (for switching), power fuses, and out-going pothead.





S&C Metalclad Switchgear weighs 60% less — requires 50% less floor space

This S&C Metalclad Switchgear unit, rated 13.8 kv, weighs only 4500 lb., requires only 36 square feet of floor space (excluding aisle space), yet costs only $5,000. Why? Through the simplicity of S&C's design. Power fuses provide fault protection and load interrupters do the switching. Result: the most dependable yet most economical protection possible for high voltage power circuits in industrial and commercial installations. Besides initial low cost here's how else you save:

Low installation costs. Because S&C switchgear is lighter it's easy to uncrate, handle and move into place. Often you can utilize space on roofs or balconies without the expense of reinforcing. The S&C unit shown here weighs only 125 lb. per square foot—60% less than other types of metalclad switchgear.

Less floor space. S&C switchgear is shallower. (The unit shown here is only three feet, eight inches deep.) It can be backed against a wall since rear access is not required. No extra floor space is needed at the front for drawout. So you can cut your floor requirements 50%.

Power fuses give protection against permanent destructive faults. Industrial and commercial high-voltage power circuits are not subject to transient faults and so don't need the automatic reclosing feature of the circuit breaker.

S&C fused interrupter gear meets the new National Electrical Code requirements for fault closing. It is available in short circuit interrupting ratings up to 500 mva at 14.4 kv, 250 mva at 4.16 kv. Continuous current ratings are 200, 400, and 720 amperes. Maximum capacity of main bus, 2000 amperes.

S & C ELECTRIC COMPANY

4421 Ravenswood Avenue • Chicago 40, Illinois

Specialists in High Voltage Circuit Interruption since 1911

S&C

lon legs. However, because they constitute a very important part of the tower, from the standpoint of cost, a great deal of care has been taken to make them as light and easy to manufacture as possible, while at the same time securing a sufficiently rigid construction. Lower beams are made up of two U-beams with bolted diagonals of angle steel. The other parts are also made of angle steel. Use of welding for details in the cross arms has kept their weight low. Total weight of a standard cross arm is only 2.05 tons yet it is able to sustain very strong forces, from ice-covered conductors and line breaks.

Tower legs rest on a trestle of steel that protrudes about 1 ft above the ground. The trestle, in turn, rests on a grillage of impregnated wooden sleepers held together by two U-beams. Normally this grillage is at a depth of 4.4 ft, but in frost breaking ground it is put deeper. Since the foundations are subject only to vertical pressure, they can be made very small and will therefore be inexpensive. Normally the grillage consists of only four impregnated wooden sleepers with a length of 4.3 feet. In ground with a lower bearing capacity the grillage area must be increased.

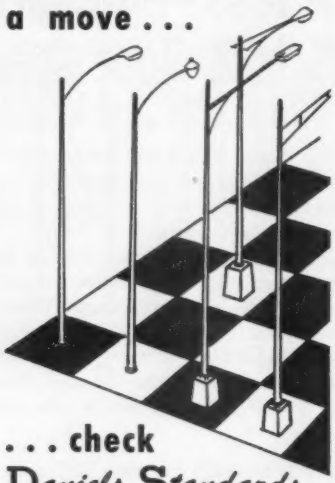
According to loading assumptions, the greatest force in the guys is 25 tons. Each of the four guys consists of a double guy wire with a 0.3 sq in. cross-sectional area and a breaking strength of 90 tons per sq in. By using a double guy wire there is no need to cut the wire for fastening in the cross arm. Instead, it can be placed over a vaulted beam.

The double guy wires are fastened to the foundation by a device with screws by which the tension can be adjusted. The grillage used for anchoring the guys consists of wooden sleepers, generally seven in number, that are 8.5 ft long and kept together by a steel beam. Normally it is not necessary to have an excavation depth of more than 6.5 ft. At every tower site there are two guy anchorages, each of these being common to two guys. Because the two guys that go to the same anchorage cannot be fully loaded at the same time, it has been possible to keep down the size of anchorages.

Towers are entirely dependent upon guys for their stability. It can be argued that this is not desirable, that guys are often more liable to damage than other parts. This, however, does not agree with experience on previously-built lines, where guys were used in angle towers to take up the forces due to deviation. Since experiences with such guys has been extremely satisfactory, we have not hesitated to use them to the extent required in the new tower.

The new tower is not suitable for angle towers if the deviation exceeds 1-2 deg. In such cases the tower needs to be supplemented by further guys; so many, in fact, that the construction would not be very suitable. However, standardized building elements have also been used in angle towers shown. Legs are the same as those used in the tangent tower. The standard foundations can also be used. Only some of the upper parts of the tower and the cross-arm have to be of special design. Angle towers of the design chosen are very stable and form points of rigid support in the line.

Before you make a move . . .



. . . check
Daniels Standards

Complete, detailed information on steel or aluminum lighting standards and strain poles is available from Daniels Standards, Inc. This new company, composed of old hands in the industry, has just published catalogs on standards and poles made in one of the finest production facilities in the country.

Before you make any move in lighting get the latest information for your requirements. Just write on your company letterhead for any or all of these brand new catalogs:

- **Steel Octagonal and Round Lighting Standards.**
- **Aluminum Octagonal and Round Lighting Standards.**
- **Strain Poles.**

Daniels Standards, Inc.

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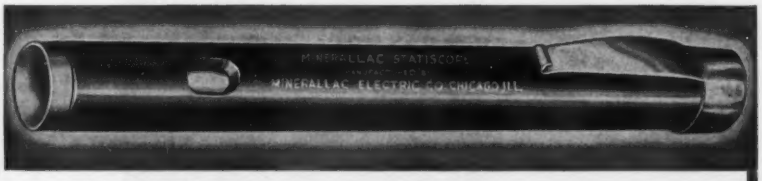
NASHVILLE 3, TENNESSEE



"VOLT-TELLING" STATISCOPE protects worker

. . . when held in alternating electrical field. Indicates presence of voltage in AC and Pulsating DC Circuits and in various electrical apparatus. . . . Pocket-size illustrated above, also in Station and Overhead Extension types. Thousands in use. Order from Electrical Jobber. Send for new literature.

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ROECLAMPS®

With Associated Cables

ARE BEST BY TEST

(and here's how we know!)

Up till now, in the absence of industry-wide specifications, it's been a catch-as-catch-can proposition to choose the *best* cable-clamp combination. Claims were all you could hang your hat on! But now a cycle of extensive field trials and laboratory tests prove more conclusively than ever that Roebling Roeclamps with Associated Cables provide the very best, most enduring circuit you can install. Here are the facts. They speak for themselves.

15 KV ROECLAMP TESTS

TESTS ON CLAMPS ALONE	ROECLAMP	SPACER A	SPACER B	SPACER C	SPACER D	SPACER E
Downward Breaking Strength*	1600	150	890	2200	?	?
Sideway Breaking Strength*	800	300	1475	100	?	?
Lightning and Tree Shielding Angle	16°	30°+	30°+	30°+	30°+	30°+
Short Circuit Breaking Strength	10,000 3ø Amps	?	?	?	?	?
Short Circuit (Design Test) Guarantee	Yes	No	No	No	No	No
TESTS WITH CONDUCTORS IN PLACE						
35 KV between phases	No Tracking 12 Months	Tracking end of 6 Months	Tracking end of 6 Months	Slight Tracking end of 1 Month	No Tracking end of 1 Month	?
35 KV between messenger and phase conductor	No Tracking 12 Months	Tracking end of 6 Months	Tracking end of 6 Months	Slight Tracking end of 1 Month	Slight Tracking end of 1 Month	?
Radio Interference Tests						
(a) by Corona Level Test Set	16 KV 1ø	?	No Tests	No Tests	?	?
(b) by AM Radio within 2 ft of phase conductor	26 KV 1ø	?	No Tests	No Tests	?	?
Impulse Strength	*171 KV	?	No Tests	No Tests	?	?

*Test made only on 5 KV Roeclamps with Associated 5 KV Cables.

MORE FACTS ABOUT ROECLAMPS

They're available for systems up to 15kv... they minimize tree problems, save 75% over self-supporting cables, and can be installed quickly, even with "boxing" gloves on... they don't have to be removed when making phase changes, or reinforcing system... they provide better voltage regulation and higher current-carrying capacity... they practically eliminate outages from falling limbs or lightning... and they give a more compact, more attractive installation! Let your Roebling representative show you the Roeclamp... or write today for an interesting, free booklet. Roebling's Electrical Wire Division, Trenton 2, New Jersey.

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4—1000 KVA Mol 7200/12470Y—4160
3—1000 KVA G-E 34500-7200/12470Y
4— 500 KVA G-E 34500-7200/12470Y
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3— 500 KVA G-E 22000—2300/4000Y
3— 333 KVA W-H 13200—2400/4160Y
3— 333 KVA G-E 66000—2400/4160Y
3— 333 KVA Wag. 2400—120/240
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Minimum 18 months with indicated maximum 3 years. Comfortable family accommodations provided, full transportation, adequate living allowances, privileges, and high salary for fully qualified engineer.

All replies completely detailing education professional status and experience, past earning record and references, will be promptly acknowledged.. Reply

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The Meetings Calendar

AUGUST

American Institute of Electrical Engineers—Pacific General Meeting, El Cortez Hotel, San Diego, Aug. 8-12.

Heat Transfer Conference & Exhibit—Sponsored by ASME and AICE, Statler-Hilton Hotel, Buffalo, Aug. 15-17.

SEPTEMBER

Edison Electric Institute—Street and Highway Lighting Committee, Salem, Sept. 1-2; Residential Lighting Promotion Committee, Cleveland, Sept. 12-13; EEI-AGA Accounting Division & Section Organization Meetings, The Pittsburgh Hilton, Pittsburgh, Sept. 15-16; Meter & Service Committee, Westchester Country Club, Rye, N. Y., Sept. 18-21; Residential Electric Heating & Air Conditioning Committee, New York City, Sept. 19-20; Commercial Electric Space Heating & Air Conditioning Committee, Columbus, Sept. 20-21; Industrial Power & Heating Group, Milwaukee, Sept. 21-23; Farm Group Meeting, New York City, Sept. 26-27; Commercial Lighting Committee, Birmingham, Sept. 26-27; Residential Appliance Promotion Committee, New York City, Sept. 26-27; Industrial Relations Committee, 13th Annual Round Table Conference, Drake Hotel, Chicago, Sept. 26-28; Home Service Committee, Fort Worth, Sept. 29-30.

Southeastern Electric Exchange — Personnel Administration Section, Roanoke Hotel, Roanoke, Sept. 1-2; Accounting Conference, Tides Hotel, St. Petersburg, Sept. 29-30.

Association of Illinois Electric Cooperatives—Annual Meeting, St. Nicholas Hotel, Springfield, Sept. 7-9.

Northwest Electric Light & Power Association—53rd Annual Meeting, Glacier Park Lodge, Glacier, Mont., Sept. 7-9.

Joint Automatic Control Conference—Sponsored by ISA, ASME, AIEE, IRE, AIChE, Massachusetts Institute of Technology, Cambridge, Mass., Sept. 7-9.

Rocky Mountain Electrical League—Annual Fall Conference, Hilton Hotel, Denver, Sept. 7-10.

American Society of Mechanical Engineers—International Air Pollution Congress, Statler-Hilton Hotel, New York City, Sept. 10-11.

Electrical Living Show—New York Coliseum, New York City, Sept. 10-18.

Illuminating Engineering Society — 1960 National Technical Conference, Penn Sheraton Hotel, Pittsburgh, Sept. 11-16.

Northwest Public Power Association—Accounting Section, Annual Meeting, Wenatchee, Wash., Sept. 14-15; Power Use Section, Annual Meeting, Hotel Monticello, Longview, Wash., Sept. 29-30.

Public Utilities Advertising Association—Region 5, Annual Meeting, Tampa Terrace Hotel, Tampa, Sept. 15-16.

Public Utilities Association of the Virginias—Executive Committee, White Sulphur Springs, W. Va., Sept. 15; 42nd Annual Meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., Sept. 15-17.

Municipal Electric Utilities Association of New York State—30th Annual Conference, Lake Placid Club, Sept. 15-17.

Pennsylvania Electric Association—Annual Meeting, Penn Sheraton Hotel, Pittsburgh, Sept. 21-22.

• **Industrial Electronics Symposium**—Manger Hotel, Cleveland, Sept. 21-22.

Inter-Industry Farm Electric Utilization Council—7th Annual National Electric Farm Power Conference, Kentucky Hotel; Louisville, Sept. 21-23.

• **National Power Conference**—Sponsored by American Institute of Electrical Engineers and American Society of Mechanical Engineers, Bellevue-Strafford Hotel, Philadelphia, Sept. 21-23.

• **Missouri Valley Electric Association**—Accounting Conference, President Hotel, Kansas City, Sept. 22-23.

• **Tennessee Valley Public Power Association**—Annual Meeting Power Use Section, Noel Hotel, Nashville, Sept. 26-27.

• **International Association of Electrical Inspectors**—Eastern Section, Wentworth-by-the-Sea, Portsmouth, N. H., Sept. 26-28.

• Additions this week.

Electrical World's Second Street and Highway Lighting Conference — Hotels Ambassador, Chicago, Ill., Oct. 19-20.

Advertising Index

Allis-Chalmers Mfg. Co...2nd Cover, 22
Anaconda Wire & Cable Co..... 19

Chance Co., A. B..... 69

Daniels Standards Inc..... 76
Delta-Star Electric Division
H. K. Porter Company, Inc..... 68
Directory of Engineers..... 78
Duncan Electric Co., Inc..... 53

Engineers, Directory of..... 78

G&W Electric Specialty Co..... 18
General Electric Co.
Apparatus Dept. 39, 41, 43
45, 47, 49
Electric Comfort Heating Section
66, 67

I-T-E Circuit Breaker Co.....50, 51
Indiana Steel & Wire Co., Inc..... 48

Kuhlman Electric Co.....4th Cover

Lapp Insulator Co., Inc.....6, 7
Line Material Industries.....20, 21

Mineralac Electric Co..... 76
Moloney Electric Co.....8, 9

National Electric Coil
Div. McGraw-Edison Co..... 73

Ohio Brass Co..... 15
Okonite Co. 4

Palnut Co. 54
Pennsylvania Transformer Div.
McGraw-Edison Co. 56
Phelps Dodge Copper Products Corp.. 10

Reynolds Metals Co.....3rd Cover
Roebling's Sons Corp., John A..... 77

S&C Electric Co.....74, 75
Searchlight Section 79
Southern States Equipment Corp...16, 17

United States Rubber Co..... 55

Wagner Electric Corp.....70, 71
Westinghouse Electric Corp.
61, 62, 63, 64

PROFESSIONAL SERVICES 86

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 87

EQUIPMENT
(Used or Surplus New)
For Sale 87

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Reynolds 5005 aluminum alloy conductor is ideal for many overhead cable applications. It is excellent as the neutral messenger in triplex, provides low cost installations on distribution lines, and is adaptable for many high voltage lines. In addition, it is especially attractive for reconductoring, and can be used in special cable constructions. Reynolds 5005 is light in weight—stringing and handling costs are reduced. Since there is no steel core, splicing is easier, and there is no possibility of galvanic corrosion. Minimum guaranteed conductivity 53.5%. Complete data available from your nearest Reynolds branch office, Reynolds Electrical Distributor, or *Reynolds Metals Company, P.O. Box 2346-EL, Richmond 18, Virginia.*

Watch Reynolds TV Shows: "Bourbon Street Beat" and "Adventures in Paradise"; and, resuming in October, "All Star Golf"—ABC-TV

Kuhlman announces:

12% uprating OF ALL "POLE-TYPE" TRANSFORMERS

Featuring longer-life SPI-65* insulation with 65° rise

The new '60 dual-rated transformer includes an "ALL NEW" core and coil with better voltage regulation, more revenue per transformer, smaller, lighter, more efficient design.

Kuhlman transformers, known through the years for their high overload capacity, are now being uprated 12%. This means all "pole-type" ratings and medium power transformers through 10,000 KVA will have dual name plate ratings. For example, a transformer formerly rated 25 KVA provides 25 KVA performance at 55° temperature rise and 28 KVA performance at a 65° rise with no sacrifice in transformer life.

This uprating, which has been a performance fact for some time, is possible because of the excellent temperature rise characteristics inherent in all Kuhlman transformers. Now, longer-life SPI-65* insulation has also been added. The combination of inherent low temperature rise and SPI-65* provides both uprating and longer life to suit the loading practices that best meet your needs.

No longer is it necessary to choose between inherent thermal characteristics and super insulation. Kuhlman now offers both in one design. Ask your Kuhlman representative to show you why now, more than ever, your transformer dollar goes farther with Kuhlman.

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Manufacturers of transformers since 1894

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